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THE RELATION OF CHEMISTRY TO AGRICULTURE[1]

THE dedication of a new chemical laboratory to the service of agriculture is an event which suggests to the mind a variety of thoughts for reflection. When an institution of learning replaces a structure inadequate to its needs by one that is larger and more modern, it simply illustrates in a very concrete way the change from the old order to the new which is continually taking place in both the material and intellectual worlds. But when, as in the present instance, the dedication of a new laboratory is in commemoration of a former revered teacher and investigator of agricultural chemistry our thoughts are turned backward as well as forward. Almost unconsciously we begin to reflect upon those principles of our science which were transmitted to us by the chemists of previous generations as a basis for our own development and as a foundation for future progress.

The year 1924, which marks the completion and dedication of the Goessmann Chemistry Laboratory of the Massachusetts Agricultural College, is in many respects an anniversary in the history of agricultural chemistry. It was just one hundred years ago that Justus von Liebig established his famous laboratory at Giessen, where he began a series of epoch-making discoveries that changed the course of chemical and agricultural science. Going back another century to 1724, we find an English clergyman, Stephen Hales, in the retirement of his curacy at Teddington actively engaged in experiments to show how much nourishment plants derive from the air—a group of researches which were incorporated three years later in a well-known treatise entitled, "Vegetable Statics." Going back still another hundred years to 1624, we find a Belgian physician, Jean Baptiste van Helmont, in the intervals of his medical practice at Vilvoorden, experimenting with his newly discovered *spiritus sylvester,* or carbon dioxide. This backward glance of three centuries, to the time when New England was first being settled, takes us to the very threshold of agricultural chemistry as a science, for it was van Helmont who by means of quantitative experiments first pointed out the path of future progress and who, although himself unable to become disentangled from the obstacles of mysticism, was yet the earliest to see an opening through the thick forest of speculation in which the human mind had been vainly circling about for a period of two thousand years.

[1] Address given at the dedication of the Goessmann Chemistry Laboratory of the Massachusetts Agricultural College, Amherst, Massachusetts, October 3, 1924.

Let us pause for a moment to consider the state of agricultural chemistry as it existed prior to the work of van Helmont. Like many other sciences it had made no progress since the time of Aristotle, whose theorizing upon natural phenomena was based upon the doctrine of the four elements. The different characteristics of soils, plants and animals were explained by their variable content in earth, water, air and fire, while the growth, death and decay of living organisms were attributed to a gain or loss in one or more of these four essential elements. An excess of any one of these gave a substance a preponderating share in the properties of hot, cold, dry or wet, as the case might be. The functions of the animal organism were thus attributed to the four humors, each of which was produced from foods of the requisite elementary property, those of a warm nature, such as mustard, being more productive of bile and those of a cold nature, such as melons, being more productive of phlegm. The expression "cool as a cucumber" is simply a survival of this ancient philosophy of nutrition which had its followers well into the eighteenth century. In the same way that the humors were each produced by particular vegetables, we find the latter to require for their growth a similar adaptation of soils, those which were warm being necessary for the plants that generate bile and those which were cold being required for the plants that give rise to phlegm. Such, in substance, was the theory of agricultural chemistry that prevailed before the time of van Helmont.

It is interesting to follow the interpretation of natural processes as the ancient Greeks explained them by their theory of elements. Take the phenomena of combustion as it is described by Heron of Alexandria, one of the most skilful experimenters of antiquity. "Bodies are consumed," he writes in the introduction of his "Pneumatics," "by fire which transforms them into finer elementary substances—namely, water, air and earth. That they are actually consumed is evident from the carbonaceous residue which, although occupying the same or a little less space than before combustion, nevertheless differs greatly with respect to the weight the material had at the beginning."

We have in this passage with its allusions to weight an early hint of the application of quantitative methods to the analysis of organic substances. Heron describes in his "Pneumatics" the most highly developed and elaborate forms of apparatus; without knowing it he had at his disposal every substance and every device necessary for establishing the true composition of the gaseous products of combustion. The only obstacle to his accomplishing this was the general acceptance of a false system of scientific inquiry, which working by the unproductive *a priori* method employed experiments to illustrate preconceived theories rather than to discover new truths. This attitude of mind, which closed the door to all progress, prevailed until the time of van Helmont, who, although himself greatly hampered by some of the inherited ideas of Greek philosophy, was yet among the first to make quantitative chemical experimentation the basis for the acquisition of new knowledge. Let us cite for comparison a combustion experiment of van Helmont which is somewhat similar to the one described by Heron.

> From 62 pounds of oak charcoal there is obtained by combustion one pound of ash. The remaining 61 pounds therefore consist of that spirit of wood (*spiritus sylvester*) which even under ignition can not escape from a closed vessel. This spirit, hitherto unknown, I call by the new name Gas. . . . Many bodies in fact contain this spirit and certain ones are entirely converted into it, not indeed because it is actually present in them as gas (since it could not be held in a compact form but would entirely escape) but it exists there as a condensed spirit, fixed like a corporeal substance from which it may be liberated by the action of a ferment, as in the case of wine, must, bread, mead, and the like.

Van Helmont's identification of the gas formed by the combustion of wood with that obtained by fermentations and by the action of acid upon limestone was one of the first important generalizations in the history of agricultural chemistry. He erred, however, in supposing this gas to be a transformation product of water, which, like the Greek philosopher Thales, he considered to be the elementary basis of all matter. But van Helmont always gave a good explanation for the truth as he saw it and it is interesting to trace the lines of his argument in a famous experiment which has been quoted by many writers upon chemistry from Boyle to the present time.

> I was able [writes van Helmont] to show by the following experiment that all vegetables are produced immediately and materially from the single element water. I took an earthen vessel in which I placed 200 pounds of soil previously dried in an oven. I then watered it with rain water and planted therein a willow branch weighing 5 pounds. After an interval of 5 years the tree which had sprung up weighed 169 pounds and some 3 ounces. The earthen vessel which was always watered when necessary with rain or distilled water was large and embedded in the ground; lest any flying dust should get mixed with the soil an iron cover plated with tin and provided with a large opening closed the mouth of the vessel. I did not determine the weight of leaves which fell during the four autumns. At the end of the experiment I dried the soil again in the vessel and obtained the same weight of 200 pounds lacking about 2 ounces. The 164 pounds of wood, bark and roots were therefore derived from water alone.

As Sir Michael Foster observes, this research is one of which an agricultural experiment station of to-day

need not be ashamed. The conclusion is wrong, to be sure, but the technique is excellent. The experiment is a classic, for it marks the beginning of the quantitative methods by which future progress in agricultural chemical research was to be made.

If we trace a chronological graph for the development of agricultural chemistry we find that it proceeds from remote antiquity, with no indication of progress, in an almost horizontal line until, at the time of van Helmont, it begins to show a slight deviation upward. With the passing decades the contributors to the science occur with greater frequency and the curvature increases, approaching more and more a vertical line. Following van Helmont we note Glauber, one of the earliest advocates of mineral manures; Boerhaave, the first to investigate carefully the chemical composition of plants; Hales, to whose "Vegetable Statics" a previous reference has been made; Margraff, a great student of plant constituents and the discoverer of beet sugar; Ingenhousz and Priestley, who made the first studies upon assimilation; until finally, after passing a number of less prominent chemists, we come at the close of the eighteenth century to the name of Lavoisier, the first to give a clear explanation of respiration, the first to set forth the fundamental law of the cyclic relation between the processes of plant and animal life and the first to make calorimetric studies upon the production of animal heat. Following the constructive work of this great discoverer the names of the contributors to agricultural chemistry come so rapidly that in the thirty years subsequent to Lavoisier's death more new knowledge was acquired than in all previous time.

This rapid sketch of the progress of agricultural chemistry brings us to the year 1824, so momentous for chemistry and agriculture, when Liebig established his laboratory at Giessen, and it will repay us for a moment to consider an interesting fact relating to the career of this chemist. The first years of Liebig's activity at Geissen were spent in zealous cooperation with his friend, Wöhler, in the study of certain problems of plant and animal chemistry, the most important of these being the investigation upon amygdalin, the first of the glucosides, and that upon uric acid. It was during this very productive period of organic research, when the doctrine of compound radicles and other fundamental theories were established, that Liebig was led to consider the practical bearing of the new discoveries in chemistry upon agriculture—the oldest of the human arts. This gradual change of interest from organic to agricultural chemistry was viewed by some of Liebig's friends with apprehension. When Dumas, the victor over Liebig in the famous substitution controversy, asked his rival rather tauntingly how it happened that he came to change so completely from organic to agricultural chemistry, Liebig replied in a bantering way, "I have withdrawn from organic chemistry because with the theory of substitution as a foundation the structure of chemical science can now be built up by workmen; masters are no longer needed." This ironical retort must not be taken too literally; yet it serves to illustrate the completeness with which Liebig had transferred his attention to agricultural chemistry.

We should perhaps consider at this point the scope of the science which Liebig and his followers brought into so great a prominence during the eighteen forties and fifties. The admirers of that delightful Connecticut essayist, "Ik Marvel," will recall in his "Farm of Edgewood" a very entertaining chapter in which the author denies the existence of any such science as agricultural chemistry.

> People talk of agricultural chemistry [he writes] as if it were a special chemistry for the farmer's advantage. The truth is (and it was well set forth, I remember, in a lecture of Professor Johnson) there is no such thing as agricultural chemistry, and the term is not only a misnomer but it misleads egregiously. There is no more a chemistry of agriculture than there is a chemistry of horse-flesh, or a conchology of egg-shells. Chemistry concerns all organic and inorganic matters; and if you have any of these about your barnyards, it concerns them; it tells you—if your observation and experience can't determine—what they are. Of course it may be an aid to agriculture; and so are wet weather, and a good hoe, and grub, and commonsense and industry.''

There was always much truth concealed in the levity of "Ik Marvel" and we may indeed well ask ourselves why we speak so constantly of agricultural chemistry and so rarely of agricultural physics or agricultural meteorology. In fact, when we review the titles of the classic books upon the subject, we note an apparent hesitancy on the part of many authors to employ the term "agricultural chemistry." Gyllenberg's ancient treatise, the oldest of all, "The Natural and Chemical Elements of Agriculture," Boussingault's "Rural Economy" and Liebig's "Natural Laws of Husbandry" imply much more than chemistry; Dana's "Muck Manual," Norton's "Scientific Agriculture" and Johnson's "How Crops Grow" are similar illustrations on the part of American authors. It was principally due to the example of Davy, Lawes and Gilbert, Johnston and other English authors that the term "agricultural chemistry" came into extensive use.

Agricultural chemistry in its present generally accepted meaning treats of the composition of soils, crops and animals and of the mutual chemical relations of these in so far as they concern the production of the means of human subsistence and comfort. Like "municipal chemistry," "military chemistry" and similar general expressions, it is a comprehensive term

which includes not only much of chemistry but touches also upon mineralogy, physics, meteorology, plant and animal physiology, mycology and other correlated sciences. The unqualified expression, "agricultural chemistry," is in fact so limited for the field which it is supposed to cover that we can well understand the preference of the older writers for more general terms, such as "rural economy" and "natural laws of husbandry." There is no field of applied chemistry which is broader in its scope or more comprehensive in the circle of its numerous bearings than that pertaining to agriculture. Consider for a moment the relationships of plant to soil and of animal to plant, the compensating balance between the processes of assimilation and respiration, the interplay of chemical, physical and biological forces which produce soil fertility from minerals and from the residues of plant and animal life. The comprehension in its numerous details of a science which involves such complicated factors as these requires a broadness of view that is not found in a narrow specialist. The great chemists who have been interested in husbandry, such as Saussure, Davy, Chaptal, Boussingault and Liebig, were men of broad scientific culture who were attracted to agriculture by the universal character of its appeal. The chemists who gave distinction to early agricultural research in the United States possessed a similar breadth of training. They were men of the type of Johnson, Goesmann, Hilgard and others who established the first state agricultural experiment stations and who, although chemists by profession, could realize that the greatest opportunity for service and progress in agricultural research is in the borderland where chemistry comes into contact with other sciences.

No better illustration can be given of the qualities necessary for producing a successful agricultural chemist than is furnished by the career of Dr. Goessmann. His intimate schooling in the fundamentals of organic chemistry and his technical experience in sugar and salt manufacture enabled him to give agricultural research a practical as well as a scientific trend. Probably no chemist ever succeeded so well as he in the difficult task of combining these two mutually repellent spheres of activity—regulatory work and scientific research—so that we find him simultaneously engaged in inspecting and analyzing commercial fertilizers and in investigating the physiological effect of special chemical manures upon the carbohydrate content of different fruits. His researches upon sorghum and sugar beets, fruit culture, ensilage making, vegetable production, forage crops and animal feeding gave an impress to the character of the work which many experiment stations took up in the early years of their formation. No one had a clearer idea than he of the importance of constantly correlating the work of the field with that of the laboratory or a keener realization of the varied applications of chemistry to all the phases of agricultural research.

As we compare the achievements of Goessmann and his compeers with those of later workers it would seem as if chemists, with the passing of these pioneers, no longer exerted a controlling influence in agricultural science. The first directors of our state experiment stations were mostly chemists, and the problem of chemical fertilizers, to which they gave so much attention, was successfully solved. Has chemistry, with the solution of this great practical problem, ceased to play an important rôle in American agricultural research or have other sciences, hitherto neglected, attained a more commanding position? A brief survey of American agricultural research may help us to answer this question.

According to the latest compilation of the Office of Experiment Stations of the U. S. Department of Agriculture, there are 5,240 research projects now being conducted by the different state experiment stations. Of these, approximately 31 per cent. are classified as relating to field crops, 17 per cent. to horticulture, 9 per cent. to plant pathology, and 8 per cent. to entomology. Over 60 per cent. of the research projects of our agricultural experiment stations relate to crop production or protection, while only about 20 per cent. pertain to the production, nutrition and diseases of farm animals. The major stress which is placed upon crops by our experiment stations is rightly directed, the approximate total value of farm crops and animal products for the United States during 1923 being, respectively, ten and six billion dollars. Of the remaining agricultural projects classified by the Office of Experiment Stations, approximately 10 per cent. relate to soils and fertilizers and 10 per cent. to a miscellaneous group, comprising agricultural economics, engineering, technology, forestry, chemistry, bacteriology and meteorology. In this large list of over 5,000 projects only 76, or 1.4 per cent., are classified under chemistry, these relating principally to the composition of plant and animal products and to methods of chemical analysis. This statistical review of American agricultural research is sufficient to show that although chemists may possibly excel in point of numbers upon the staffs of our agricultural colleges and experiment stations the final aims of agricultural research are but seldom chemical in themselves.

This brief survey we have made does not indicate, however, the proportion of agricultural research projects in which chemistry plays a cooperating part. If the various projects under soils, fertilizers, in-

secticides, nutrition, etc., which in any way invoke the assistance of chemistry be enumerated, they are found to make up over 20 per cent. of the total. A careful review of the situation shows that the rôle of chemistry in agricultural research is not diminishing but increasing, although the results are neither so spectacular nor so strikingly remunerative as in the days of fertilizer examination. Agrarians, horticulturalists, entomologists, pathologists, technologists and other agricultural specialists are employing chemistry to an ever-increasing extent in the solution of their respective problems. If chemists in the past few decades have lost the prominence which they once held in agricultural research it is because they have permitted others to lead in the work of scientific collaboration. Extreme specialization may perhaps have narrowed our vision to the point of overlooking the fact that chemistry in its relation to agriculture is not an end but a means, and thus of neglecting the opportunities in that fertile region where chemistry and the other sciences overlap. It is in the coordination of chemistry with other sciences that the agricultural chemist of the future must be trained. Such an attitude brings not a relinquishment but an enlarged conception of the relations of chemistry to agriculture.

The field is so vast that it is impossible to indicate in this brief address the nature and variety of the problems which await solution. The agricultural chemist is not concerned, as in the early days, with the mere chemical analysis of soils and crops and animals, but rather with the dynamic rôle which is played by the constituents in the soil solution and in the fluids of the living organism. He does not consider the question of fertilizing for the increased production of grain or seed alone, but also for the increased yield of oil or carbohydrate or protein. The old problems of the chemical composition and rôle of humus need to be reopened; old experiments with fertilizers and cattle feeds need to be reviewed and repeated in the light of newer knowledge. What are the effects of the lesser studied elements, such as boron, iodine, fluorine, manganese, aluminum, etc., upon the growth and function of plants and animals? What are the factors which control the acidity or alkalinity of soils and their influence upon the production of different crops? What are the chemical, physical and biological functions of the numerous bacteria, fungi, protozoa and other microorganisms that inhabit the soil? For the solution of these and the many other important problems which might be named, the agricultural scientist needs to equip himself with the latest methods of research and to summon to his aid the resources and appliances of every science, but of chemistry foremost among all. For, after all is said, the chemical elements in their various combinations are the basis for the material existence of soils and crops and animals; eliminate these and the whole fabric of agriculture dissolves, leaving "not a rack behind." No scientist is so competent as the chemist to understand the fundamental laws which underlie the processes of agriculture and no scientists have described so well as chemists the operations of these laws in the classic works upon husbandry.

This new laboratory, which is dedicated to the service and advancement of agriculture, is for the purpose of instruction as well as of research. However great may have been the increase in chemical knowledge during the past century, it is doubtful if the spirit or method of instruction is any better than that employed by Liebig in the laboratory which he established at Giessen just a century ago. It is fittingly described by one of his pupils, the late Professor Johnson, in an address before the Connecticut Board of Agriculture in 1873, when in speaking of the critical method of scientific inquiry, he said:

> It was in that spirit that Baron Liebig instructed the students who gathered in his laboratory from all quarters of the globe to learn the art of making discoveries in science. They were set to testing the truth of some idea, or the connection of some fact, or else to make new observations and discover new facts to lead to new ideas. It was not the novelty or the glory of discovery, but the genuineness of discovery that was regarded as of first importance. He listened patiently to their accounts of each day's progress, considered their plan of investigation, saw the apparatus or arrangements they devised, witnessed the observations they were led to, and heard the theories they imagined. He encouraged, but he criticized. He asked questions, suggested doubts, raised objections. His students were required not only to collect facts, or supposed facts, and to connect and complement them by comparison, analogies and theories but they were made to attack their theories in every weak point and to verify or disprove the supposed facts by scrutiny from every side.

The fruits of Liebig's teaching are a sufficient proof of the value of this method of instruction.

What lessons are so suggestive as the subject-matter of agricultural chemistry for arousing the interest and intelligence of youth! The basic principles of life and culture are here involved and the teacher has at his command a multitude of themes touching all the commonplace phenomena of our daily existence. Such themes have inspired the greatest thinkers, for they form the warp which holds together the fabric of our civilization. It was Emerson who once exclaimed:

> What would we really know the meaning of? The meal in the firkin, the milk in the pan—show me the

ultimate reason of these matters; show me the sublime presence of the highest spiritual cause lurking, as it does lurk, in these suburbs and extremities of nature; let me see every trifle bristling with the polarity that ranges it instantly on an eternal law;—and the world lies no longer a dull miscellany and lumber room but has form and order.

The field of service to which this laboratory is dedicated is fertile; the outlook is vast; the future is full of promise, for never have the opportunities of applying chemistry to agriculture been greater. The reward, moreover, is certain, provided its devotees preserve the spirit and breadth of vision which actuated the founders of our science.

C. A. BROWNE
BUREAU OF CHEMISTRY
U. S. DEPARTMENT OF AGRICULTURE

PREPROFESSIONAL TRAINING AS REVEALED BY THE NEEDS OF THE PHYSICIAN[1]

THE need of premedical training, as a foundation for a medical education, is evident, and its importance is recognized. What is not so clear, however, and what is not so easily decided, is how broad and deep and firm a foundation is required for the medical superstructure. Just as any building must always be considered, as a whole, before the type of foundation can be determined, so, in the same way, the problem of medical education, in its entirety, must be thought of, the better to understand and appreciate the kind of premedical instruction necessary. It is, therefore, hoped that by calling your attention, on the one hand, to what the finished product of a medical school should be, and, on the other hand, to the deficient product that is produced, you will be helped to realize the urgent need there exists for certain modifications of the present-day premedical courses.

The ultimate aim of the science and art of medicine is (1) to preserve or restore health, (2) to prolong life or (3) to alleviate suffering. The most important object of medical education is to prepare young men and young women to carry out these aims, *i.e.*, to qualify them to practice medicine. Since there is such a misunderstanding as to what the practice of medicine implies, and since the premedical teacher should be familiar with what being a physician means, it might not be amiss, at this point, to define it. The practice of medicine implies (1) an ability to diagnose the patient's ailment, and (2) an ability to take care of the patient, *i.e., to* treat him by any one or more of all the known and recognized preventive and remedial measures that the diagnosis might indicate and suggest. Ability to diagnose is, of course, dependent upon a thorough knowledge (1) of the fundamental sciences—normal and pathological physiology, chemistry and anatomy, and (2) of the exciting and predisposing causes of disease. Ability to treat implies first of all an ability to diagnose, because diagnosis indicates and suggests the kind of treatment necessary, and second it presupposes a knowledge of therapeutics which means the taking care of a patient by any one or more of the following measures: (1) preventive, (2) suggestive, (3) dietetic, (4) physical, (5) hydrotherapeutic, (6) medicinal, (7) mechanical, (8) operative, etc., etc. It further assumes a proper and sympathetic attitude towards the patient. In the building up of a medical education, therefore, therapeutics is the ultimate aim. All other subjects are important only in so far as they throw light on it. In other words, the young doctor, the product of the medical school, should be a humanized being, one qualified by education and training (1) to determine, by diagnosis, what measure or measures are indicated, and (2) to faithfully carry out such treatment, or, if he can not do so himself, he will arrange that another, qualified, shall do it for him.

One need not travel far nor search long for evidence that the product of the present-day medical school is being found wanting. While it is clear there is trouble, it is not easy to localize it and determine its cause. Undoubtedly, the public is to blame on the one hand, and, on the other hand, the schools are certainly at fault. Unlike the successful business corporation which is vitally interested in the turning out of its wares in the form of finished products, because that means satisfied consumers and continued success, the schools have been more or less indifferent to the needs of their graduates, their interest in these ceasing largely at commencement time. And so we find, among others, the graduate in medicine, handicapped by his training or lack of training, unable to do full justice to his patients and to himself.

Though irregular practitioners and patent medicine venders have always been with us, and probably always will be, it is a fact that they are thriving to-day as never before. The United States Bureau of Census, in its 1919 report, gives figures which indicate that the value of patent medicines and compounds increased from $83,771,154.00 in 1909 to $102,463,400.00 in 1914 and to $212,185,700.00 in 1919, a percentage increase in the ten-year period, 1909 to 1919, of approximately 250 per cent. B. C. Keller, in an article, "Laity's idea of physician," ap-

[1] Read before the Association of Urban Universities, November, 1923.

pearing in the 1923 July number of the *Illinois Medical Journal*, and quoted in the *Literary Digest* for September 22, 1923, shows that of 6,772 persons, from all walks of life, interviewed, 5,841 or 87 per cent. were against the regular physician as evidenced by their faith in and patronage of irregulars. This state of affairs is, indeed, all the more deplorable when we call to mind the fact that the public is able to enjoy more perfect health and thus to live a more complete life because of the profession of medicine's constant and self-sacrificing efforts in its attempt to prevent disease and preserve health. The gullibility of the public, therefore, must explain, in a measure at least, its attitude towards the profession.

The schools, both medical and premedical, must, however, shoulder the biggest share of the responsibility. Answers to the question, "What do you consider was lacking, if anything, in your medical school course to fit you for your particular work?" asked of Harvard Medical School graduates, in a questionnaire sent to them about twelve years ago ("The profession of medicine," A. B. Emmons), brought out the fact that of all answering practically 50 per cent. agreed on the one point that a knowledge of therapeutics was their greatest lack. While this reflects conditions as they were some fifteen years ago, in spite of splendid advancements made, there still remains much to be done. That needed improvements are necessary to-day is evidenced by such articles as "Medical education as revealed by the war" (N. B. Foster, *J. A. M. A.*, 5/24/19), "The teaching of therapeutics" (Hare, *J. A. M. A.*, Feb., 1920), "The practitioner's view of the defects of medical education" (Blumer, Proceedings of Thirtieth Annual Meeting of Association of American Medical Colleges, March, 1920), etc., which call our attention to existing defects. However, it must be said to the credit of medical educators: (1) that they are aware of these defects, as reference to a series of papers on medical education in the 1919 *Edinburgh Medical Journal*, and a similar series of articles appearing in the Proceedings of the Association of American Medical Colleges, for the past several years, will show, and (2) that they have been and are considering ways and means of improving the medical course.

After duly charging the public on the one hand and the medical school on the other with the responsibilities that are theirs, there remains no small balance of blame that must be charged to the premedical training. When the Council on Education of the American Medical Association, in 1914, required one premedical year, and in 1918 two premedical years, consisting, in both instances, of prescribed courses in the sciences, with freedom in the choice of enough electives to make up the total required hours, for admission to its class A schools, it undoubtedly had for its object a better prepared medical student. Now, after these years of trial, in the light of the evidence presented, it is not at all surprising that it is becoming more and more questionable whether the added requirements are producing the desired results. The fact that two years ago five schools (Johns Hopkins, Cornell, Western Reserve, Leland Stanford Junior and the University of California) were requiring three years or more of premedical preparation for admission, and that now, in addition, five other schools (Yale, Rush, Dartmouth, Pennsylvania and Oregon) have joined them indicates that these ten schools believe the two-year requirement insufficient and inadequate.

The needs of the practitioner of medicine, as revealed by this study, suggest, among others, the following modifications of the present premedical curriculum, and these are respectfully offered for your consideration:

(1) As medicine is an art as well as a science, the cultural subjects and the humanities should be given greater consideration than they now receive. In the present two-year requirement 28 semester hours in the sciences and six semester hours in English are prescribed, but entire freedom is allowed in the choice of enough electives to make up the total number of hours, the emphasis being on the hours and not on the subject-matter. The implication is that the scientific instruction is the important phase of the premedical training and that nothing else matters. While this may be true, so far as immediate needs go, it is equally as true that such reasoning ignores the needs of the future. Both types of subject are certainly very essential and neither can replace the other. Whereas too much emphasis on the scientific side tends to make the student an unsympathetic and "cold-blooded proposition," the broadening influences of these other subjects make for a humanized being. What is needed is a balanced course—one built especially for the student by the combined efforts of premedical and medical educators. And in this connection we might ask—Is not a complete arts and science course, as a premedical requirement, worthy of most careful consideration?

(2) As the physician works with living patients, he must, of necessity, deal with the human mind. Therefore, psychology, now only a recommended subject, should be a required one.

(3) If ever there was need for the break between the premedical and medical subjects, that need certainly does not exist to-day. It is bad, pedagogically, to say the least. As the laws of physics, chemistry and biology must be applied in diagnosing diseases and treating patients, it is highly important, in the

teaching of these subjects, that the instructors understand the relations between their own subject and what follows. This appreciation will be lacking until there is a greater working together of premedical and medical teachers. For, isn't it as important that the instructor in physics, say, should cooperate with the instructor in physiology as it is for the latter to work with the clinical teacher? Therefore, a greater cooperation between the various teachers concerned with the training of a medical student is urged, in the hope that a better correlation of subjects and a more efficient course will follow.

In conclusion, may we anticipate that to your efforts will be due no small amount of credit for making of the future medical graduate a more finished product.

E. W. KOCH

SCHOOL OF MEDICINE,
UNIVERSITY OF BUFFALO

SCIENTIFIC EVENTS

THE NATIONAL SCIENTIFIC SOCIETIES MEETING IN WASHINGTON DURING CONVOCATION WEEK, DECEMBER 29, 1924, TO JANUARY 3, 1925

THERE have been printed in SCIENCE articles concerning the approaching meeting of the American Association for the Advancement of Science and the national scientific societies associated with it. A list of the sections of the association and of the societies with the principal officers, including the addresses of the secretaries, is as follows:

President

J. MCKEEN CATTELL, Garrison-on-Hudson, N. Y.

Retiring President

CHARLES D. WALCOTT, Smithsonian Institution, Washington, D. C.

Vice-presidents and Retiring Vice-presidents for the Sections

Section A (Mathematics)

Vice-president, J. C. FIELDS, University of Toronto, Toronto, Canada.

Retiring Vice-president, HARRIS HANCOCK, University of Cincinnati, Cincinnati, Ohio.

Section B (Physics)

Vice-president, K. T. COMPTON, Princeton University, Princeton, N. J.

Retiring Vice-president, W. F. G. SWANN, University of Chicago, Chicago, Ill.

Section C (Chemistry)

Vice-president, F. G. COTTRELL, Fixed Nitrogen Research Laboratory, American University, Washington, D. C.

Retiring Vice-president, E. W. WASHBURN, National Research Council, Washington, D. C.

Section D (Astronomy)

Vice-president, JOHN A. MILLER, Swarthmore College, Swarthmore, Pa.

Retiring Vice-president, HEBER D. CURTIS, Alleghany Observatory, Pittsburgh, Pa.

Section E (Geology and Geography)

Vice-president, W. C. MENDENHALL, U. S. Geological Survey, Washington, D. C.

Retiring Vice-president, N. M. FENNEMAN, University of Cincinnati, Cincinnati, Ohio.

Section F (Zoological Sciences)

Vice-president, EDWIN LINTON, 1104 Milledge Road, Augusta, Ga.

Retiring Vice-president, E. L. RICE, Ohio Wesleyan University, Delaware, Ohio.

Section G (Botanical Sciences)

Vice-president, G. R. LYMAN, West Virginia University, Morgantown, W. Va.

Retiring Vice-president, C. J. CHAMBERLAIN, University of Chicago, Chicago, Ill.

Section H (Anthropology)

Vice-president, E. A. HOOTON, Peabody Museum, Cambridge, Mass.

Retiring Vice-president, E. A. HOOTON, Peabody Museum, Cambridge, Mass.

Section I (Psychology)

Vice-president, R. S. WOODWORTH, Columbia University, New York, N. Y.

Retiring Vice-president, G. STANLEY HALL, *deceased.*

Section K (Social and Economic Sciences)

Vice-president, THOMAS S. BAKER, Carnegie Institute of Technology, Pittsburgh, Pa.

Retiring Vice-president, JOHN F. CROWELL, 171 Liberty St., Bloomfield, N. J.

Section L (Historical and Physiological Sciences, History of Science)

Vice-president, LOUIS C. KARPINSKI, University of Michigan, Ann Arbor, Mich.

Retiring Vice-president, FLORIAN CAJORI, University of California, Berkeley, Calif.

Section M (Engineering)

Vice-president, A. E. KENNELLY, Harvard University, Cambridge, Mass.

Retiring Vice-president, JOHN T. FAIG, Ohio Mechanics Institute, Cincinnati, Ohio.

Section N (Medical Sciences)

Vice-president, WILLIAM A. MACCALLUM, Johns Hopkins University, Baltimore, Md.

Retiring Vice-president, RICHARD P. STRONG, Harvard University Medical School, Boston, Mass.

Section O (Agriculture)

Vice-president, L. R. JONES, University of Wisconsin, Madison, Wis.

Retiring Vice-president, R. A. PEARSON, Iowa State College, Ames, Iowa.

Section Q (Education)

Vice-president, L. A. PECHSTEIN, University of Cincinnati, Cincinnati, Ohio.

Retiring Vice-president, HENRY W. HOLMES, Harvard University, Cambridge, Mass.

Permanent Secretary

BURTON E. LIVINGSTON, Johns Hopkins University, Baltimore, Md. (Association mail address: Smithsonian Institution Building, Washington, D. C.)

General Secretary

D. T. MACDOUGAL, Desert Laboratory, Tucson, Ariz.

A. Mathematics

The American Mathematical Society.
OSWALD VEBLEN, *president.*
R. G. D. RICHARDSON, *secretary*, Brown University, Providence, R. I.
December 30–31.

The Mathematical Association of America.
H. L. REITZ, *president.*
W. D. CAIRNS, *secretary*, Oberlin, Ohio.
December 31–Jauuary 2.

The Pi Mu Epsilon Mathematical Fraternity.
E. D. ROE, JR., *director-general.*
WARREN G. BULLARD, *secretary-general*, 117 Redfield Place, Syracuse, N. Y.

B. Physics

The American Physical Society.
CHARLES E. MENDENHALL, *president.*
HAROLD W. WEBB, *secretary*, Columbia University, New York, N. Y.
December 29–31.

The American Meteorological Society.
W. I. MILHAM, *president.*
CHARLES F. BROOKS, *secretary*, Clark University, Worcester, Mass.
January 2–3.

D. Astronomy

The American Astronomical Society.
W. W. CAMPBELL, *president.*
JOEL STEBBINS, *secretary*, Washburn Observatory, Madison, Wis.
December 31–January 1.

E. Geology and Geography

The Association of American Geographers.
CURTIS F. MARBUT, *president.*
CHARLES E. COLBY, *secretary*, University of Chicago, Chicago, Ill.
December 31–January 3.

The Seismological Society of America.
BAILEY WILLIS, *president.*
S. D. TOWNLEY, *secretary*, Stanford University, Calif.

The American Geographical Society.
JOHN GREENOUGH, *president.*
ISAIAH BOWMAN, *director*, 3755 Broadway, New York, N. Y.

The National Council of Geography Teachers.
W. R. MCCONNELL, *president.*
GEO. J. MILLER, *secretary*, Mankato, Minn.
December 29.

The American Alpine Club.
HARRY P. NICHOLS, *president.*
WALTER D. WILCOX, *secretary*, 1526 New Hampshire Ave., Washington, D. C.

F. Zoological Sciences

The American Society of Zoologists.
R. G. HARRISON, *president.*
W. C. ALLEE, *secretary*, University of Chicago, Chicago, Ill.
December 29–31.

The Entomological Society of America.
CHARLES W. JOHNSON, *president.*
C. L. METCALF, *secretary*, The University of Illinois, Urbana, Ill.
December 29–31.

The American Association of Economic Entomologists.
A. G. RUGGLES, *president.*
ALBERT F. BURGESS, *secretary*, Melrose Highlands, Mass.
December 31–January 3.

The Eugenics Research Association.
ALBERT JOHNSON, *president.*
H. H. LAUGHLIN, *secretary*, Cold Spring Harbor, New York.

American Society of Mammalogists.
WILFRED H. OSGOOD, *president.*
HARTLEY H. T. JACKSON, *corresponding secretary*, Bureau of Biological Survey, U. S. Department of Agriculture, Washington, D. C.
April 8–10, 1925.

The Wilson Ornithological Club.
ALBERT F. GANIER, *president.*
GORDON WILSON, *secretary*, State Normal College, Bowling Green, Ky.

G. Botanical Sciences

The Botanical Society of America.
WILLIAM CROCKER, *president.*
I. F. LEWIS, *secretary*, University, Va.
December 29–31.

The American Phytopathological Society.
F. D. FROMME, *president.*
R. J. HASKELL, *secretary*, U. S. Department of Agriculture, Washington, D. C.
December 29–January 1.

The American Society of Plant Physiologists.
CHAS. A. SHULL, *president.*

R. B. HARVEY, *secretary*, University of Minnesota, Minneapolis, Minn.
December 29–January 2.

The Botanists of the Central States.
H. C. COWLES, *president.*
EDWARD A. BURT, *secretary*, Missouri Botanical Garden, St. Louis, Mo.

The American Fern Society.
WILLIAM R. MAXON, *president.*
CHARLES S. LEWIS, *secretary*, 835 Edgewood Ave., Trenton, N. J.
January 1.

The Sullivant Moss Society.
ROBERT S. WILLIAMS, *president.*
EDW. B. CHAMBERLAIN, *secretary*, 18 West 89th Street, New York, N. Y.

The Wild-Flower Preservation Society of America.
H. C. COWLES, *president.*
MRS. N. L. BRITTON, *secretary*, New York Botanical Garden, Bronx Park, New York, N. Y.
December 28.

F–G. Zoology and Botany

The American Society of Naturalists.
W. H. HOWELL, *president.*
A. FRANKLIN SHULL, *sercetary*, University of Michigan, Ann Arbor, Mich.
January 1.

The Ecological Society of America.
E. N. TRANSEAU, *president.*
A. O. WEESE, *secretary*, University of Oklahoma, Norman, Okla.
December 30–January 1.

The American Genetic Association.
DAVID FAIRCHILD, *president.*
SEWALL WRIGHT, *secretary*, P. O. Box 354, Pennsylvania Ave. Station, Washington, D. C.

The American Microscopical Society.
B. H. RANSOM, *president.*
PAUL S. WELCH, *secretary*, University of Michigan, Ann Arbor, Mich.
December 31.

The American Nature-Study Society.
M. R. VAN CLEVE, *president.*
MRS. ANNA B. COMSTOCK, *secretary*, 123 Roberts Place, Ithaca, N. Y.
December 29–30.

The Phi Sigma Biological Research Society.
EMORY W. SINK, *president.*
C. J. REED, *secretary*, 5216 Greenwood Ave., Chicago, Ill.
December 29.

H. Anthropology

The American Anthropological Association.
WALTER HOUGH, *president.*
A. V. KIDDER, *secretary*, Phillips Academy, Andover, Mass.
January 1–3.

The American Folk-Lore Society.
ELSIE CLEWES PARSON, *president.*
GLADYS A. REICHARD, *secretary*, Barnard College, New York N. Y.
December 30–31.

I. Psychology

The American Psychological Association.
G. STANLEY HALL, *president, deceased.*
JOHN E. ANDERSON, *secretary*, Drawer 13, Yale Station, New Haven, Conn.
December 29–31.

The Southern Society for Philosophy and Psychology.
BUFORD JOHNSON, *president.*
O. R. HUGHES, *secretary*, West Tennessee State Normal School, Memphis, Tenn.

K. Social and Economic Sciences

The American Political Science Association.
JAMES W. GARNER, *president.*
FREDERIC A. OGG, *secretary*, University of Wisconsin, Madison, Wis.
December 29–31.

The Metric Association.
GEORGE F. KUNZ, *president.*
HOWARD RICHARDS, *secretary*, 156 Fifth Ave., New York, N. Y.
December 29–30.

N. Medical Sciences

The American Physiological Society.
A. J. CARLSON, *president.*
WALTER J. MEEK, *secretary*, University of Missouri, Columbia, Mo.
December 29–31.

The Society of American Bacteriologists.
A. PARKER HITCHENS, *president.*
J. M. SHERMAN, *secretary*, Cornell University, Ithaca, N. Y.
December 29–31.

The American Society for Pharmacology and Experimental Therapeutics.
JOHN AUER, *president.*
EDGAR D. BROWN, *secretary*, University of Minnesota, Minn.
December 29–31.

The American Society of Biological Chemists, Inc.
PHILIP A. SHAFFER, *president.*
D. WRIGHT WILSON, *secretary*, University of Pennsylvania, Philadelphia, Pa.
December 29–31.

The American Society for Experimental Pathology.
A. S. WARTHIN, *president.*
E. B. KRUMBHAAR, *secretary*, Laboratories, Philadelphia General Hospital, Philadelphia, Pa.
December 29–31.

O. Agriculture

The American Society of Agronomy.
M. F. MILLER, *president.*

P. E. BROWN, *secretary*, Iowa State College, Ames, Iowa.
December 31.

The Society of American Foresters.
WALTER MULFORD, *president*.
ROBERT V. REYNOLDS, *secretary*, U. S. Forest Service, Washington, D. C.
December 30–31.

The American Society for Horticultural Science.
M. J. DORSEY, *president*.
C. P. CLOSE, *secretary*, College Park, Md.
December 29–31.

The American Pomological Society.
PAUL C. STARK, *president*.
H. C. C. MILES, *secretary*, Milford, Conn.

The Association of Official Seed Analysts.
M. T. MUNN, *president*.
A. L. STONE, *secretary*, University of Wisconsin, Madison, Wis.
December 31–January 2.

The Potato Association of America.
A. G. TOLAAS, *president*.
WILLIAM STUART, *secretary*, U. S. Department of Agriculture, Washington, D. C.
December 29–January 3.

The American Dairy Science Association.
A. A. BORLAND, *president*.
J. B. FITCH, *secretary*, Manhattan, Kans.

The Crop Protection Institute.

Q. Education

The National Society of College Teachers of Education.
E. F. BUCHNER, *president*.
ARTHUR J. JONES, *secretary*, University of Pennsylvania, Philadelphia, Pa.

The National Society for the Study of Education.
GUY M. WHIPPLE, *secretary*, 10 Putnam St., Danvers, Mass.

The American Federation of Teachers of the Mathematical and Natural Sciences.
R. C. MANN, *president*.
WM. A. HEDRICK, *secretary*, Central High School, Washington, D. C.

The American Philosophical Association.
ALEXANDER MEIKELJOHN, *president*.
C. I. LEWIS, *secretary*, Harvard University, Cambridge, Mass.

The Phi Delta Kappa Fraternity.
LEWIS W. WILLIAMS, *president*.
ABEL J. MCALLISTER, *secretary*, 2118 West 109th St., Chicago, Ill.
December 31.

Societies Not Specially Related to Any Particular Section

The Society of Sigma Xi.
F. K. RICHTMYER, *president*.
EDWARD ELLERY, *secretary*, Union College, Schenectady, N. Y.
December 30.

The American Association of University Professors.
A. O. LEUSCHNER, *president*.
H. W. TYLER, *secretary*, Massachusetts Institute of Technology, Cambridge, Mass.
December 27–29.

The History of Science Society.
L. J. HENDERSON, *president*.
F. L. BRASCH, *secretary*, Department of Terrestrial Magnetism, Carnegie Institution of Washington, D. C.
December 31–January 1.

The Gamma Alpha Graduate Scientific Fraternity.
E. M. GILBERT, *president*.
L. M. HUTCHINS, *secretary*, Fort Valley, Ga.
January 1.

The Sigma Delta Epsilon Graduate Women's Scientific Society.
December 29 and 31.

The Bibliographical Society of America.
AZARIAH S. ROOT, *president*.

The Gamma Sigma Delta Society.
A. F. WOODS, *president*.
J. O. RANKIN, *secretary*, Agricultural Experiment Station, Lincoln, Neb.

The Phi Kappa Phi Fraternity.
J. S. STEVES, *president*.
L. H. PAMMEL, *secretary*, Iowa State College, Ames, Iowa.

SCIENTIFIC NOTES AND NEWS

AT the opening session of the approaching fifth Washington meeting of the American Association for the Advancement of Science, to be held in the Memorial Continental Hall on the evening of Monday, December 29, at 8:30, the Honorable Charles Evans Hughes, Secretary of State, will address the association on "Some aspects of international cooperation." At the same session the retiring president, Dr. Charles D. Walcott, secretary of the Smithsonian Institution, will give the retiring presidential address on "Science and service."

THE executive committee of the council of the American Association for the Advancement of Science will hold its first Washington session at the Cosmos Club, Washington, on Sunday afternoon, December 28, at 4:00 o'clock. The business to be considered includes some important matters, such as the question of academy affiliation and the interpretation of fellowship rules. Communications for the committee should reach the permanent secretary, at the Smithsonian Institution Building in Washington, before December 26. The executive committee will hold its second session at the New Willard Hotel on Monday, December 29, at 10:00 o'clock. The council of the association will hold its first Washington session at the New Willard Hotel on Monday, December 29,

at 2:00 o'clock. Communications for the council should be sent to the permanent secretary's office as above.

DR. THEODORE LYMAN, professor of physics at Harvard University, and Dr. Gilbert N. Lewis, professor of chemistry at the University of California, have been elected honorary members of the Royal Society, London.

THE Nichols medal of the New York Section of the American Chemical Society for 1925 has been awarded to Dr. Edward Curtis Franklin, professor of organic chemistry at Leland Stanford University. The medal is bestowed annually "for the research published during the current year which in the opinion of the jury is most original and stimulative to further research."

THE American Institute of Mining and Metallurgical Engineers has awarded its James Douglas gold medal to William H. Bassett, metallurgist of the American Brass Company, Waterbury, Conn.

JOHN W. HOWELL, of Newark, N. J., has been awarded the Edison medal for the year 1924 for his contributions towards the development of the incandescent lamp. The medal is awarded annually by a committee of twenty-four members of the American Institute of Electrical Engineers.

A PORTRAIT bust of Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, was presented to Dr. Flexner on December 13 at a dinner held at the Ambassador Hotel, New York City. The bust is by the Russian sculptor, Konenkov. The presentation was made by a group of friends of Dr. Flexner in appreciation of his influence in the medical and allied sciences, and the dinner was attended by about two hundred persons. Addresses were made by Mr. John D. Rockefeller, Jr., Dr. Phoebus A. Levene, Professor Augustus Trowbridge and Professor T. H. Morgan. Dr. Frederick Peterson read an appreciative poem and the address of presentation was made by Dr. William H. Welch. Mr. Raymond B. Fosdick acted as toastmaster.

HENRY R. KRAYBILL, professor of agricultural chemistry and chemist in the Agricultural Experiment Station of the University of New Hampshire, has resigned to accept a position as biochemist in the Boyce Thompson Institute for Plant Research, Inc., Yonkers, N. Y. Joseph T. Sullivan, formerly graduate assistant in the department of agricultural chemistry, University of New Hampshire, has been appointed assistant biochemist in the institute.

J. A. PIECE, university fellow of the Lick Observatory, has been appointed astronomer at the Dominion Astrophysical Observatory, Victoria, B. C.

DR. JOSEPH S. REICHERT has resigned his professorship in the department of chemistry of the University of Notre Dame, Indiana, in order to accept a position in government work at the Edgewood Arsenal.

P. B. MEYERS has been appointed chemist at the Agricultural Station at the University of Delaware, in the place of L. W. Tarr, who has resigned.

DR. GEORGE DE SCHWEINITZ has been elected trustee of the University of Pennsylvania in place of the late Dr. Robert G. Leconte.

DR. R. K. NABOURS, head of the department of zoology at the Kansas State Agricultural College, has been elected a member of the advisory council of the Eugenics Committee of the United States.

C. E. SKINNER, assistant director of engineering of the Westinghouse Electric and Manufacturing Company, has been elected chairman of the American Engineering Standards Committee.

THE fourth fellowship to be awarded by the Canadian Society of Technical Agriculturists for professional distinction was conferred at its recent annual convention at Guelph, Ontario, on W. T. Macoun, Dominion horticulturist since 1910.

JAMES KENDALL, professor of chemistry at Columbia University, has been named chairman for 1925 of the New York section of the American Chemical Society. Dr. B. T. Brooks, a consulting chemist, is vice-chairman, and D. H. Killeffer, associate editor of *Industrial and Engineering Chemistry*, secretary-treasurer.

DR. ARISTIDES AGRAMONTE, professor of bacteriology at the University of Havana, has been appointed to represent the Cuban government at the third Pan-American Scientific Congress that will take place in Lima, Peru, from December 20 to January 6, 1925.

GEORGE L. MEYLAN, professor of physical education and a member of the faculty of applied science, represented Columbia University at the ceremonies commemorating the fiftieth anniversary of the founding of the Ecole Polytechnique at the University of Brussels, Belgium, held on November 20, 21 and 22.

DR. L. M. MASSEY, head of the department of plant pathology at Cornell University, has been granted sabbatic leave and will spend nine months, beginning January 1, in research at the Boyce Thompson Institute for Plant Research, at Yonkers, New York.

EDWIN H. BRYAN, entomologist on the staff of Bernice P. Bishop Museum, has returned to Honolulu after a cruise of nine months on board the schooner *France* of the Whitney South Seas Expedition. February and March were spent at Nassau, Puka Puka,

the Phoenix Islands and Fakaofo; April and May in Samoa; and the time from June to November was given to a study of the Fiji Archipelago, particularly of the little known islands lying between Viti, Levu and Tonga. The collections made by Mr. Bryan are chiefly insects, land shells and plants; his notes include also ethnological and geological material.

DR. ALICE HAMILTON has returned from Russia to take up her work in industrial toxicology in the Harvard School of Public Health.

THE Rockefeller Institute for Medical Research has invited six specially qualified bacteriologists, selected from as many foreign countries, to come to New York for a three months' course in the methods of cultivation and identification of certain filter-passing microorganisms isolated by Drs. Olitsky and Gates. The bacteriologists, one each from England, France, Belgium, Italy, Germany and Denmark, will arrive about the end of December.

DR. MARGARET B. MACDONALD, associate and research professor of biochemistry at the School of Hygiene, Johns Hopkins University, is visiting the University of Illinois for the year and is doing research work on the biochemistry of yeast.

DR. F. O. ANDEREGG and Dr. P. R. Judy, of Purdue University, have returned from Bedford where they went to make a study of Indiana limestone ledges in connection with an investigation of the causes of efflorescence of limestone.

MRS. ETHEL PARSONS, of the staff of the International Health Board, who for the past three years has been serving as general superintendent of the Service of Nursing and Nursing Education of the National Department of Health of Brazil, is in the United States on leave of absence. She will sail for Brazil on December 20 to resume her post.

DR. KURT KOFFKA, professor of psychology at the University of Giessen, who has come to the United States to lecture at Cornell University, gave during December a series of lectures on the psychology of learning at Harvard University.

BEGINNING on December 12, Dr. Morton Prince, of Boston, gave a series of three lectures at Clark University or abnormal psychology.

ON December 6, Dr. Raymond Pearl, of the School of Hygiene and Public Health, Johns Hopkins University, delivered an address to the Royal Canadian Institute, Toronto, on the subject "The experimental study of life duration."

PROFESSOR A. S. EDDINGTON, of Cambridge University, England, gave a lecture on "The theory of relativity," before the Swarthmore Chapter of Sigma Xi, on December 9. The lecture was attended by about one hundred and fifty members and guests of the chapter.

IN the interest of the American School of Prehistoric Research in Europe, Mrs. George Grant MacCurdy is giving illustrated public lectures on "Prehistoric art and religion." The first lecture of the season was given at Smith College on December 15.

PROFESSOR ERNST J. BERG, of Union College, Schenectady, delivered a course of six lectures during the week of December 1 under the auspices of the department of electrical engineering of Washington University, St. Louis. His subject was "The use of Heaviside's operators in engineering and physics."

AT the opening, October 6, of the new Pathologic Institute of McGill University Faculty of Medicine, Montreal, which owes its being in part to the Rockefeller Foundation, New York, the chief address was delivered by Dr. Arthur E. Boycott, Graham professor of pathology, University of London.

THE Finlayson Memorial Lectures of the Royal Faculty of Physicians and Surgeons of Glasgow were elivered on November 20 and 24 by Sir Leonard Rogers. His general subject was "Pathological evidence bearing on disease incidence in Calcutta," the first lecture dealing with disease in general and the second with simple and malignant tumors.

DR. EDMUND CLARK SANFORD, head of the department of psychology at Clark University, where he had been a member of the faculty for thirty-five years and president of Clark College for eleven years, died suddenly from heart disease on November 22, aged sixty-five years.

ROMEYN B. HOUGH, author of the "Handbook of Trees of the Northern United States and Canada," who was known also for his fascicles of sections of North American woods, has died, aged sixty-seven years.

THE death is announced of Dr. James Mills, for twenty-five years president of the Ontario Agricultural College.

THE deaths are also announced of the following scientific men: Dr. John Beard, lecturer in cytology and comparative anatomy at Edinburgh University; Dr. Alf. Larsen, well-known Swedish engineer; Dr. Karl Hedbom, of Upsala, known for his researches on mycetes; M. L. E. Bertin, for many years director of naval construction in France, known for his work on the theory of waves; Dr. E. König, of Germany, inventor of certain photographic processes; Dr. George Rechenberg, first assistant of the observatory at Breslau; Dr. Gustav Jaumann, professor of physics in the

German Technical High School in Brunn, and Dr. Jaroslav Hlava, professor of pathologic anatomy at Charles University, Prague.

WE are informed that on October 10, following an operation for appendicitis, American science lost one of its younger scholars in the death of James Daley McDonald, at Fresno, California. Born at Clarksfield, Ohio, March 17, 1892, he was graduated from Oberlin College in 1913. The following year he entered the graduate school of the University of California where he took the doctorate degree in protozoology under Professor Charles A. Kofoid. His early professional experience was that of a teacher of biology in the Pasadena High School. Later (1917–1919) he was parasitologist of the State Board of Health of California. At the time of his death, and for several years preceding, he held the position of professor of biology at State College, Fresno, California. His four published papers (1919–1922) deal with intestinal parasites. He leaves a wife, three children and many warm friends.

A CORRESPONDENT writes that Dr. Francis Eschauzier, born at Cadiz, Spain, March 3, 1861, died on November 10. He descended from a family of botanists, and was a British subject. Juan Jacobo Scheuchzer was his grandfather's great grandfather. On his mother's side he belonged to the noble house of Terry, of Cork, Ireland. He had a brother Luis, who died some years ago, and the brothers were much interested in cacti, and to them *Cactus Eschauzieri* was dedicated by Dr. J. M. Coulter. They resided for many years in San Luis Potosí, but Dr. Eschauzier died in Mexico City.

OBSERVERS from Mount Wilson and the other observatories in California, University of Virginia, University of Wisconsin, the Harvard and Brown Universities, and possibly from the Yerkes Observatory at Chicago, Princeton University and the United States Bureau of Standards, will go to Middletown, Conn., on January 24, to view the eclipse of the sun at the Van Vleck Observatory connected with Wesleyan University. Apparatus is being sent from some of the observatories for use at Middletown.

THE Harvard College Observatory is to establish four temporary photographic stations along the path of totality of the eclipse of the sun of January 24. There will be a station at Buffalo, N. Y., and one on the island of Nantucket. The others probably will be at Poughkeepsie and near New London, Conn.

THE Rockefeller Institute for Medical Research has announced the release of the drug known as Tryparsamide for use in the treatment of human and animal trypanosomiasis (African sleeping sickness and *mal de caderas*) and selected cases of syphilis of the central nervous system. This action is based on results reported from clinical investigations which have been in progress for several years. The drug will be manufactured by the Powers-Weightman-Rosengarten Company, of Philadelphia, and will become available through the regular trade channels about January 1, 1925. In releasing the drug for the benefit of the public, the Rockefeller Institute desires it to be known that the institute does not share in any way in profits that may be derived from the sale of the drug and that, with the cordial cooperation of the manufacturers, provision has been made for the maintenance of a schedule of prices on as low a basis as possible.

A PRELIMINARY agreement has been signed, which provides land for the erection of the State Psychiatric Institute and Hospital on the site of the Columbia University and Presbyterian Hospital medical center. The agreement, signed by the chairman of the state hospital commission and the chairman of the joint administrative board of Columbia University and Presbyterian Hospital, states that the first buildings constructed will be the new Presbyterian Hospital and the College of Physicians and Surgeons, the remaining land being available for other institutions associating themselves in the development of the medical center. The new psychiatric institute (the old one is on Ward's Island) will have about 150 beds for patients under observation, and will have the use of the medical center outpatient department, thus permitting the observation and treatment of hundreds of other patients, and making possible a great extension of the present research facilities.

THE increasing demands for greater and more varied service to the members by local sections of the American Chemical Society have made the problem of financing these various proper activities extremely acute. Besides providing speakers for the monthly meetings many of the sections maintain employment bureaus, public relations committees and various other agencies for entertainment, membership, etc. The Chicago section of the American Chemical Society is seeking to solve this problem by raising an endowment of $25,000 over a period of five years. Each administration will make an effort to raise its quota. Up to the present time the subscriptions total $3,600, most of which has been paid in.

POPE PIUS presided on December 14 at the inaugural sitting of the Pontifical Academy of Science. He delivered a brief address emphasizing the efficacy of the studies of the academy and expressing his best wishes for its development. Scientific reports were read on mathematics, chemistry, physiology, medicine, meteorology and natural history.

THE Commonwealth Fund has made a grant of $15,000 for a study of foster children, the sum to be

divided equally for use by Dr. L. M. Terman, of Stanford University, and Dr. Frank N. Freeman, professor of educational psychology in the University of Chicago. Dr. Terman will compare foster children and their foster parents and Dr. Freeman will make a comparison between foster children and their brothers and sisters.

MRS. TYNDALL, widow of Professor John Tyndall, has made a donation of £500 to the Royal Society to be used at the discretion of the Tyndall Mining Bequest Committee, as a fund to meet out-of-pocket expenses incurred by the Tyndall Research Student in carrying out his investigations.

THE Japanese government has decided to allot $1,000,000 for the establishment of an Institute for Natural Science in Shanghai. The research work in the institute will include several branches of pathology, anatomy, bacteriology, parasitology, serology and Chinese pharmacology. A yearly grant of $250,000 is to be made. It is hoped that the institute will be completed within three years.

THE Field Museum of Natural History, Chicago, has been given a trust fund of $25,000 by Julius Rosenwald, of Chicago, to be used by the museum without restrictions.

UNIVERSITY AND EDUCATIONAL NOTES

GROUND was broken on November 13 for two buildings at Columbia University to house the departments of physics and chemistry. They will cost $2,150,000.

AN appeal for the Harvard Medical School dormitory among physicians and their friends has resulted in gifts of about $250,000. The university has agreed to invest from permanent funds of the school about $300,000, and there remains about $550,000 to be raised.

POMONA COLLEGE has completed the first stage in its campaign for $3,000,000. More than $800,000 in pledges has been received, assuring the General Education Board gift of $400,000.

GLASGOW UNIVERSITY has received £2,000 from the Bellahouston trustees for the purpose of providing electrical appliances for the department of natural philosophy.

DR. HOMER G. BISHOP, instructor in psychology at Cornell University, has been appointed assistant professor of psychology at Smith College.

DR. GEORGE A. MENGE, retiring chairman of the Chicago section of the American Chemical Society, has been appointed as assistant professor of chemistry at Lafayette College.

DR. ALEXANDER M. BURGESS, of Providence, R. I., has been appointed medical director and assistant professor of biology at Brown University.

PROFESSOR ANDREW ROBERTSON, professor of mechanical engineering in Bristol University, has been appointed principal of Bristol Merchant Venturers' Technical College, in succession to the late Dr. Wertheimer.

Two newly created professorships in the medical faculty of the University of Münster have been filled by the appointment of Dr. Heinrich Többen to the chair of forensic medicine, and of Dr. Hermann Freund, of Heidelberg, to the chair of pharmacology.

DISCUSSION AND CORRESPONDENCE

RELATION BETWEEN THE SURFACE TENSION AND RELATIVE DENSITY OF A LIQUID

MACLEOD has given (Faraday Soc. Trans., 19, pp. 38–41; *Sci. Abs.*, 190, 1924) an empirical relation between the surface tension λ of a liquid, its density ϱ_1 and the density ϱ_2 of the saturated vapor, which is of the form.

$$\lambda = C\,(\varrho_1 - \varrho_2)^4 \qquad (1)$$

where C is a constant which depends only on the nature of the liquid. This relation has attracted some attention, and has been used by Sugden (*Chem. Soc. J.*, 125 pp. 1177–1189, 1924; *Sci. Abs.*, 2391, 1924) in considerations of the molecular volume and constitution of a liquid. May I point out that I have previously obtained the above relation (*Phil. Mag.*, pp. 83–102, Jan., 1911). I have also deduced from theoretical considerations that the constant C is given by

$$C = 32.96\,\frac{(\Sigma \sqrt{m_1})^2}{M^2\,\varrho_c^{\,2}} \qquad (2)$$

where $\Sigma \sqrt{m_1}$ denotes the sum of the square roots of the atomic weights of the atoms of a molecule relative to the hydrogen atom, ϱ_c the critical density, and m the molecular weight relative to the hydrogen atom. For example, the values of C for the substances methyl formate, carbon tetrachloride, benzene and ether, given by equation (1) are 27.53, 3.99, 45.5 and 62.92, respectively, while equation (2) gives the values 26.93, 3.33, 41.76 and 68.77.

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THE TERMINOLOGY OF HOMOTYPES OF INSECTS

To museums generally, and to those who have not the advantages of a large state museum, in particular, the value of having representative collections of insects (in fact of all groups) comprising specimens known to agree in every detail with the types of the species they represent (homotypes) is a *desideratum* which can not be too strongly emphasized; and the present note has been written in the hope that it will enlist the cooperation of specialists in making such collections a possibility. My object has not been to provide a contribution to the terminology of "types," but mainly to recapitulate the terms which may be applied to typical specimens of a species. The phrases "agrees with type," or "compared with type" are not very satisfactory, as such specimens differ in value according to their locality, and if they are compared by the original describer of the species or not, in addition to which a uniform system of labelling is essential in a large collection. I, therefore, propose the adoption of the following terms by entomologists, which, with a few additions, are essentially the same as those used by Schuchert and Buckman[1] and recognized by Banks and Caudell.[2]

Topotype: t.t.: A specimen from the same locality as the original type of the species, with which it has been compared by a specialist other than the original describer, and found to agree in every particular.

Metatype: m.t.: A topotype, but compared by the original describer of the species.

Homeotype: h.t.: A specimen compared with the type by a specialist, and found to agree exactly, but not from the type locality.

Idiotype: i.t.: A homeotype, but compared by the original describer of the species.

Neotype: n.t.: A specimen from the same geographical region, preferably from the type-locality, chosen by a specialist or by the original describer, to replace a holotype which is destroyed or lost, or useless for comparison.

The selection of neotypes would to some extent be eradicated if typical specimens were properly labelled, as would be the necessity for regarding some species in the future as "unrecognizable;" and a proper appreciation of the fragility of insect types should in itself be an incentive to the adoption of the above terms. I would also propose that specimens which have been identified only from a description or figure should bear a label indicative of this fact. The letters "i.d." (="identified from description") written on a corner of the determination label would serve the purpose. To facilitate recognition in the cabinet typical specimens should bear a distinctive label as shown in the circlets after the terms, and it is also necessary that the authority for the identification should be made evident in the accompanying specimen label.

Homeotype.
Sphecodes
gibbus Linn.
det. R. Jones, 24

Homeotype.

A word on the necessity for the uniform designation of the primary types may not be out of place here. It is now more or less universally accepted that only one specimen of a species can represent its "type" (*Holotype*), the other specimens before the author at the time of describing being known as *paratypes,* and the type of the opposite sex to the holotype as the *Allotype.* An allotype which is described after the publication of the original description should be known by Mr. J. H. Durrant's term *Neallotype.* Many authors, however, still follow the practice of calling one specimen the type and the other examples at the time of describing cotypes, while others name all original specimens "types." This leads to much confusion, and it is desirable that a uniform system should be established and rigorously followed. The series of specimens called "types" by some authors are really cotypes, and the selection of a *lectotype* from among such series merits more universal attention. It need hardly be mentioned that lectotypes should be selected with great care. After a lectotype has been selected the remaining "types" which agree with it are known as *paralectotypes.*

The mere creation of terms for various kinds of "types," "morphs," etc., will serve no useful purpose unless the authors themselves consistently employ them. The terms of entomological nomenclature are in need of a severe revision and if this note directs attention to this need and the necessity for eliminating all unnecessary terms its aims will have been accomplished.

CEDRIC DOVER

LONDON

[1] *Ann. Mag. Nat. Hist.*, 7, xvi, p. 102, 1905.

[2] "The Entomological Code," pp. 14 and 15: Washington, 1912.

THE COSTS OF MEDICAL JOURNALS

THE enclosed sheet, showing the comparative costs of various journals to subscribers, was prepared by the publisher, J. Springer of Berlin. It was given to me through the kindness of Professor Kurt Koffka of Giessen, who is now acting professor of education in Cornell University. In these days of increased printing cost, this comparison of German, English and American prices may be of interest to scientific men. The figures give the price in cents per sheet of sixteen pages.

German	Price per sheet (16 pages)	English	Price per sheet (16 pages)	American	Price per sheet (16 pages)
Archiv für Dermatologie und Syphilis	$0.19	*British Journal of Dermatology and Syphilis*	$0.30	*Archives of Dermatology and Syphilology*	$0.06
Archiv für Gynäkologie	.21	*Journal of Obstetrics and Gynecology of the British Empire*	.24	*American Journal of Obstetrics and Gynecology*	.15
Brauer's Beiträge zur Klinik der Tuberkulose mit Zentralblatt für Tuberkulose	.21	*British Journal of Tuberculosis*	.18	*American Review of Tuberculosis*	.11
v. Greefe's Archiv für Ophthalmologie	.28	*British Journal of Ophthalmology*	.25	*Archives of Ophthalmology*	.15
				American Journal of Ophthalmology	.14
Pflüger's Archiv für die gesamte Physiologie	.22	*Journal of Physiology*	.27	*Journal of General Physiology*	.09
Zeitschrift für Hals,- Nasen und Ohrenheilkunde	.17	*Journal of Laryngology and Otology*	.16	*Laryngoscope*	.14
Zeitschrift für Hygiene	.19	*Journal of Hygiene*	.31	*Journal of Hygiene*	.15
Zeitschrift für Kinderheilkunde	.23	*British Journal of Children's Diseases*	.34	*Journal of Diseases of Children*	.06
Zeitschrift für die gesamte Neurologie und Psychiatrie	.30	*Journal of Neurology and Psychopathology*	.32	*Archives of Neurology and Psychiatry*	.07

CORNELL UNIVERSITY SETH WAKEMAN

QUOTATIONS

INTERNATIONAL CONGRESSES

IT will be remembered that the National Union of Scientific Workers issued in May a vigorous protest against the boycott of ex-enemy nations organized by the "International Research Council." This protest was given a fair amount of publicity in the press, though some journals, in particular *Nature* and *The Times*, declined to print it; and copies were sent to the principal scientific societies in Great Britain, and to a selection of foreign academies and societies.

A good many replies have been received. A number of these (for example, those of the Royal Society and the Royal Astronomical Society) are merely formal acknowledgments, stating that the secretary will bring the matter before the council of the society.

Some few societies, however, have already found time to consider the question. Thus the Optical Society has passed a definite resolution of sympathy with the attitude of the Union. The Meteorological Society is "not opposed" to the admission of ex-enemy nations to international Unions and Congresses. The Geological Society and the London Mathematical Society have never associated themselves with the boycott.

No society has, at present, expressed an opinion on the opposite side; and there can be no reasonable doubt that the Union's claim to represent, in this matter, "an overwhelming majority of British men of science," was perfectly justified.

A considerable number of replies have been received from German academies. These naturally all express agreement with our resolution, and gratitude to the Union for the stand it has taken. . . .

One "international" congress was held during the summer, the Mathematical Congress at Toronto. In connection with this, our protest excited a good deal of attention in America. It is an instructive comment on the manner in which the boycott has been organized, that many American mathematicians who attended the congress discovered for the first time when they arrived at it that Germans were excluded. A good deal of indignation was expressed, and the representatives of the American Mathematical Society moved a resolution for the removal of the ban. This

was supported by the delegates of Denmark, Great Britain, Holland, Italy, Norway, Sweden and Switzerland. It was then pointed out (as any reader of our protest could have foretold) that such a resolution was contrary to the statutes of the "International Research Council," under which the congress had been convened. In these circumstances no resolution could be carried, but it was agreed that the attention of the council should be called to the discussion; and the official proposal that the next congress should be held in Brussels, under the present regulations, was withdrawn.

It is safe to say that the Toronto congress was the last "boycott" congress of mathematics. It is possible that the International Research Council will themselves remove the ban when they meet next year. If they do not, the Union of Mathematics will collapse, or degenerate into a purely Franco-Belgian affair, and the way will be clear for the revival of a genuinely international congress.—Professor G. H. Hardy in *The Scientific Worker*.

SPECIAL ARTICLES

THE BRIGHTNESS OF MARINE LUMINESCENCE

IN 1922[1] the present writer published a comparison of the brightness of several luminescent substances, including that of a sample of luciferin kindly presented to him by Professor E. Newton Harvey. More recently there have been opportunities to estimate the brightness of luminescence of several marine forms.

In the former experiments[1] use was made of an optical pyrometer of the type in which an incandescent filament is superimposed upon the glowing surface, the brightness of which is to be measured. This instrument was calibrated to read in millilamberts instead of degrees of temperature.

When it comes to the measurement of the light given out by marine forms in the open sea it is almost impossible to use the pyrometer because of the difficulty of bringing these fleeting patches of light into the field of the instrument. It was found possible however by looking at the image of the filament with the right eye, while the left eye was free to observe whatever gleams of light came into the field of unobstructed vision from the water toward which the observer was looking, to adjust the filament to equality of brightness with the luminescence thus observed. Readings made in this manner do not possess quite the degree of certainty of observations made in the usual way upon a fixed and steady source of light, but it was found that they were rather surprisingly consistent and satisfactory and really afforded a quite reliable estimate of the brightness of the luminescence which was to be measured.

Calibration of the instrument when thus used with two eyes is readily made by setting the filament to match the brightness of any convenient surface alternately by the binocular and the monocular method.

The following is a summary of the studies made by the method above described.

1. *At Sanibel Island, Florida:* Although this locality is noted for its marine "phosphorescence," the accounts of brilliant displays given by Rowland Ward[2] being abundantly confirmed by those who are acquainted with the surrounding waters, only the most meager exhibits were in evidence either in the passes of the Caloosahatchie River or along the shore of Sanibel Island during the fortnight in April (1924) when the writer was present. Occasional star-like sparkles and the diffuse luminescence of breaking waves were observable, however, from a fishing stage on the gulf shore of the island. These, which were presumably due to dino-flagellates, were measured.

2. *From Shipboard off the Carolina Coast:* During a trip from Jacksonville to Baltimore a few days later measurements were made of the luminescence of the bow-wave of the steamer and of the glow observable in the wake. In this case as at Sanibel Island the nights were without moon and partly cloudy.

3. *At Woods Hole:* In August of the present year, also during the dark of the moon, measurements were made from the float of the Marine Laboratory. To the members of the laboratory for this privilege and in particular to Professor Harvey, who identified the luminescent organisms, the writer wishes to express his indebtedness.

LIST OF OBSERVATIONS

Locality	Source	Brightness in millilamberts
Shipboard	A diffuse glow in the wake	.0007
"	Diffuse glow of bow wave	.0063
Sanibel Island	Diffuse glow of breaking waves	.0063
" "	Individual flashes of dino-flagellates	.116
Woods Hole	Individual flashes of dino-flagellates	.116
" "	Colonies of hydroids	.033
" "	Mnemiopsis Leidyi	.11 to .30

It is interesting to note that the diffuse glow of breaking waves, as observed at Sanibel and on shipboard, were of the same order of brightness and that

[1] Nichols: SCIENCE, lv, p. 157 (1922).

[2] Ward: "The English Angler in Florida," London, 1898.

the same is true of the flashes of light from dinoflagellates at Sanibel and at Woods Hole. In both localities the measurements were made at quite close range, the excitation of these minute organisms being apparently due to the swirl of water around piles and submerged timbers.

The colonies of hydroids, which were attached to the supporting timbers of the float at Woods Hole, were excited to momentary luminescence by rubbing with the fingers, a procedure suggested by Professor Harvey.

The finely luminescent jellyfish at the foot of the list (Mnemiopsis Leidyi), although rarely seen at Woods Hole, appeared in abundance during the writer's visit. When excited spontaneously by the swash of a quiet sea the brightness was quite uniformly .11 ml. to .12 ml. After lying at rest in a tub of sea water a sudden agitation of the organisms (as by strongly tapping the tub or stirring the water) produced an initial brightness of .30 ml., which could not be immediately repeated by the application of further excitation.

Even the dimmest of the intensities noted above, that of the faint glow observed in the wake of a steamer at sea, is about ten times what would result from the illumination of white objects by a clear but moonless sky. The foam of a breaking wave is not suitable for such a comparison, since one can not be sure of the complete absence of luminosity. A measurement of the very white shell-beach on Sanibel Island at night, which was probably comparable to sea-foam in reflecting power, was therefore selected. It was found to have a brightness of only .00008 millilamberts.

When one contemplates the vast range between such intensities and that, say, of the same beach under the noonday sun, one calls to mind Langley's classical memoir on the least quantity of light necessary to vision.

E. L. NICHOLS

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EXPERIMENTS ON THE CULTIVATION OF THE ACTIVE AGENT OF MOSAIC DISEASE OF TOBACCO AND TOMATO

THE experiments here reported relate to the problem of the cultivation of the microbic agent of mosaic disease of tobacco (*Nicotiana tabacum*) and tomato (*Lycopersicum esculentum*).

It was determined as a preliminary that the active agent was readily filterable through Berkefeld filters, sizes "V" and "N." Also the disease was transmitted from the affected tobacco to previously normal tomato plants and similarly from the tomato to tobacco, thus effecting a cross-passage. Furthermore, the signs of the mosaic disease in the tobacco and tomato plants of the initial stock and in those to which the affection was transferred experimentally were identical with those described by other investigators, notably by Allard.

The medium employed in the cultivation tests consisted of an aqueous extract of carefully selected fresh young stems, leaves and shoots from tomato plants which were shown by experiments to be free of the disease. The extract was centrifuged at high speed and filtered twice through Berkefeld "N" filters. The filtrate was retained for use if its final pH was 5.3 — 6.0 (for no artificial adjustment was made by adding acid or alkali), if no evidence of contamination existed and if none of its contained albumins or globulins were precipitated.

Materials for culture were obtained from stout tomato stems or large tobacco leaves which were cut from the plant with a razor. The cut end of the stem or the leaf was sterilized by searing in a flame and a sterile capillary pipette, connected with a small rubber bulb, was inserted into the stem or into the midrib of the petiole of the leaf, in the direction of the long axis. About 0.01 cc of liquid containing the active agent was then aspirated directly into the pipette and inoculated into 3 to 5 cc of the medium, which was then placed in a dark cabinet in the greenhouse, at a temperature of 28 to 30° C.

After seven to ten days or longer, the medium containing mosaic materials showed as a rule a faint, uniform, translucent, almost imperceptible haze. In some instances, no changes could be made out by inspection with the naked eye on comparison with the controls. Stained specimens, however, revealed more granular material than in the latter. Nevertheless, by the available tinctorial methods, by darkfield examination, by supravital and unstained preparations studied with the ordinary microscope, we failed to differentiate formed elements as distinct from the granules or precipitate which were to be found in the uninoculated medium as well.

To determine whether the agent of mosaic disease had multiplied recourse was had to the inoculation of plants. Since the agent is known to be extremely active, even in high dilutions (Allard, Doolittle), careful attention was given to the possibility that a mere transfer of the original active material from tube to tube might be responsible for the results. As will be shown in a more detailed communication to appear shortly, our tests indicated that no interpretation could be made regarding the power of a subplant in artificial media to induce mosaic disease unless the original inoculum in this subplant is diluted at least one part to a million. Under the conditions of our

experiments, this point was reached by the fourth subplant, in which latter the original inoculum was present in an estimated dilution of one to ten million.

If multiplication of the active agent be indicated by the capacity of the fourth and more remote subplants to induce mosaic disease in normal plants, then of 17 attempts to culture the active agent of tobacco and tomato mosaic, all must be considered as successful but one. It was found that normal tomato plants showed the disease on inoculation with early and remote subplants, up to the twelfth, which represented a diluted of the initial inoculum of one to 4×10^{-16}. Once the experimental disease gained a foothold, there was no difference in the severity of the affection following inoculation of the subplants from that induced by the original, undiluted active agent itself. All the characteristic signs regarded as criteria of the disease were present. The experimental mosaic disease induced by the cultural fluids could be transmitted from plant to plant in unlimited series both by direct application of the liquid of the affected plant to previously normal tomato leaves and by inoculation with the material from subplants of the liquid in the artificial medium.

In the course of the experiments a significant fact was noted, namely, that the agent present in remote subplants which can induce the disease was not readily filterable. The nature of the change thus indicated remains to be determined.

The conclusion seems justified that the incitant of mosaic disease of tobacco and tomatoes is a living, microbic body which can be cultivated in an artificial medium.

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THE AMERICAN CHEMICAL SOCIETY

DIVISION OF INORGANIC AND PHYSICAL CHEMISTRY

Graham Edgar, *chairman*
Harry B. Weiser, *secretary*

A re-determination of the heats of oxidation of certain metals: S. W. PARR and J. E. MOOSE. (1) A direct method and apparatus have been perfected for the accurate determination of the heats of oxidation of certain metals. (2) Very pure aluminium, cadmium, cerium, lanthanum, magnesium, molybdenum, tantalum, tin, tungsten, and zinc have been completely oxidized inside a specially designed combustion crucible and the thermal effect of the oxidation measured. (3) Beryllium has been partially oxidized and the thermal effect measured. (4) Certain metals may be completely oxidized inside a Parr oxygen bomb when sized and arranged properly about a fuse wire within a combustion crucible and subjected to thirty atmospheres pressure of oxygen. (5) The values recorded for the same metal agree more closely than those that have been obtained by indirect methods.

The mechanism of acid catalysis of ester hydrolysis: JAMES KENDALL and CECIL V. KING. Freezing point determinations have been made upon dilute aqueous solutions of ethyl acetate; hydrochloric, trichloracetic, monochloracetic and acetic acids; and equimolecular mixtures of each of these acids with ethyl acetate, in concentrations up to the limit of solubility of ethyl acetate. Specific conductivities have been measured, at 0°, upon solutions of these acids and their equimolecular mixtures with ethyl acetate. The velocity of hydrolysis of ethyl acetate, at 0°, was measured, in the latter solutions. The approximate solubility of ethyl acetate, at 0°, in these solutions was noted. Experiments were carried out to determine the effect of the presence of ethyl acetate upon the velocity of inversion of cane sugar when catalyzed by hydrochloric acid. The collected data have been analyzed with the object of determining the state of molecular complexity in the acid-ester solutions, and the effect of water upon acid-ester compounds. The bearing of the results obtained upon the dual theory of acid catalysis and upon Rice's theory of catalysis by unhydrated hydrogen ion has also been considered.

A new energy relation governing liquids and vapors: J. E. MILLS. The author has previously shown in a long series of articles published mainly in the *Journal of Physical Chemistry* that molecular forces obey the law,

$$1. \quad f = \frac{-m_1 E}{s^2}$$

where f is the force acting between two molecules, m_1 is the mass of a molecule, E is a constant

$$= 31414 \sqrt[3]{\frac{3}{4\pi}} \sqrt[3]{m_1 \mu^1}$$

and s is the distance through which the force acts.

It is now shown that under this law

$$2. \quad \mu^1 \sqrt[3]{d_o} - \left(\mu^1 \sqrt[3]{d} + \frac{Ej}{2} \right) = \text{energy given out on changing from the density at the absolute zero to any other density d (liquid) or D (vapor)} = C\ R\ T\ \ln \frac{d^\circ}{d}.$$

Ej is the temperature energy of the molecules. C is the constant of Dieterici's equation for the internal heat of vaporization, namely, $\lambda = C\ R\ T \ln \frac{d_o}{d}$

$$3. \quad \mu^1 \sqrt[3]{d_o} = \mu^1 \sqrt[3]{d} + \frac{Ej}{2} + C\ R\ T \ln \frac{d_o}{d} \text{ for liquid}$$

$$= \mu^1 \sqrt[3]{D} + \frac{Ej}{2} + C\ R\ T \ln \frac{d_o}{D} \text{ for vapor.}$$

This equation has been tested for ethyl oxide, di-isopropyl, di-isobutyl, isopentane, normal pentane, nor-

mal hexane, normal heptane, normal octane, benzene, iodo-benzene, carbon tetrachloride and stannic chloride from 0° C. to the critical temperature of the substance. The results calculated from the liquid and from the vapor are in remarkable agreement and in all substances investigated the results agree with the values obtained at the absolute zero. The equation, therefore, confirms in the most striking manner the fact that the molecular attractive forces vary inversely as the square of the distance apart of the molecules. Also the equation gives a new energy relation apparently holding true for all non-associated substances from the absolute zero to the critical temperature of the substances.

A new method of studying electrode potentials: HOMER D. HOLLER. The usual methods of measuring electrode potentials during the flow of current are subject to error because of potential difference due to resistance. The new method distinguishes between electromotive force of polarization and potential difference due to resistance. A resistance-coupled electron tube amplifier is used with an oscillograph for photographically recording the variations in electrode potential without drawing any current from the electrode which is in the grid circuit. Also by superposing an alternating current upon the electrode, the potential difference due to resistance may be obtained by measuring the a.c. component in the plate current with a separately excited wattmeter.

An oscillographic study of electrolytic rectification: HOMER D. HOLLER and JOHN P. SCHRODT. The degree of rectification and the energy efficiency obtainable with the "valve" electrode depends upon the electrical characteristics of the circuit as well as the physical dimensions and condition of the electrode. The study of the effect of these factors upon electrolytic rectification resolved itself into an analysis of the wave-form of the rectified current under different conditions. The effects of inductance with and without an iron core, capacity, counter electromotive force and temperature were demonstrated theoretically and confirmed by oscillographic records.

The activation of hydrogen in the creepage corona: F. O. ANDEREGG and W. N. HERR. Glass wool, previously found active in promoting the oxidation of nitrogen in the creepage corona, has been shown to be more helpful in activating hydrogen than either flint or earthenware fragments or a bare platinum wire. However, the glass wool tube soon loses its efficiency. It may be restored by letting a little air in and then sweeping out or by passing a discharge through pure nitrogen for a few minutes. Traces of oxygen or nitrogen added to pure hydrogen had little effect on the poisoning. Probably an active form of hydrogen is adsorbed on the glass wool.

Some experiments on the self-corrosion of lead: F. O. ANDEREGG. A study has been made of the corrosion of the commercially pure lead, the 1 per cent. antimony-lead and the 3 per cent. tin-lead used for telephone cable sheath by burying samples in many kinds of soil at room and at incubator temperature, by observing the corrosive action of solutions of varying pH, by making e.m.f. measurements and by metallographic observations. Of the three, tin-lead is most and antimony-lead usually least resistant to corrosion. The self-corrosion increases with the organic content of the soil, with the presence of salts, with the poorness of the drainage and with the presence of mortar, cement, gypsum, etc. It is dangerous to place lead in contact with the soil. Asphalt, if continuous, should give good protection. The complete details are given in Bull. 18 of the Purdue University Engineering Experiment Station.

The solubility of ferrous hydroxide and its effect upon corrosion: W. G. WHITMAN, R. P. RUSSELL, G. H. B. DAVIS. (a) *Solubility of ferrous hydroxide.* Experiments are described in which the solubility of ferrous hydroxide has been determined in water and in solutions of varying concentrations of sodium sulfate, calcium chloride, sodium chloride, ammonium chloride, magnesium chloride, sodium dichromate, sodium chromate, sodium silicate and sodium hydroxide. These solutions of ferrous hydroxide were prepared by adding pure iron powder to the deoxygenated salt solutions, which were allowed to stand until saturated with ferrous hydroxide. The solutions were then filtered under hydrogen and analyzed for iron by a colorimetric method. Data are also given whereby the solubility of ferrous hydroxide may be calculated in non-oxidizing salt solutions. The dissociation constant for ferrous hydroxide is calculated as 6×10^{-10}, the ionization in saturated solutions as 30 per cent. at 25° C., and the free energy of formation as 57,200 calories. (b) *Comparison with corrosion data.* Data on the specific rates of corrosion of iron in various salt solutions have been obtained. The corrosion results parallel the solubilities of ferrous hydroxide in the same solutions. It is suggested that this is due to changes in the protectiveness of the rust film with the solubility of ferrous rust, and that decreased solubility causes a decrease in rate of corrosion.

The activity of hydrochloric acid in ethyl alcohol: PAUL A. ANDERSON. From the experimentally determined electromotive forces of cells of the type: H_2, HCl (alcoholic), HgCl, Hg measured at 25° C. over the concentration range 0.01 to 5.0 *M* are calculated the activities, and their coefficients, of hydrochloric acid in anhydrous ethyl alcohol. It is assumed with Danner, *J. Am. Chem. Soc., 44,* 2832, (1922), that $\gamma = \frac{\lambda}{\lambda o}$ as a first approximation in dilute solutions.

The conductivity of phosgene solutions. I. Solutions of aluminium chloride in phosgene: ALBERT F. O. GERMANN. Liquid phosgene forms conducting solutions with aluminium chloride, contrary to the prediction made by Beckmann, as a result of his study of the ebullioscopy of phosgene solutions. The gaseous products of electrolysis are carbon monoxide and chlorine, which in the

type of cell used partially recombine in diffused light to form phosgene before they can be collected. The specific conductance of the phosgene used was of the order of 0.007×10^{-6} at 25°. Three series of conductivity measurements for solutions of aluminium chloride[1] used at 0° made the results at −45° appear of doubtful value, as the value of the cell constant can not be determined directly at this temperature. The value of the specific conductance at 25° rises progressively from the most dilute solutions to a value of 550×10^{-6} for the saturated solution, and increases in conductivity of the order of 10^5.

A preliminary paper on heats of adsorption from solution: D. C. LICHTENWALNER and NEIL E. GORDON. In previous papers, the adsorption of various salts by hydrous ferric and aluminum hydroxide has been reported. In this paper, the heats liberated when these salts are adsorbed by the iron and aluminum are measured, and an attempt is made to draw some conclusions between the heats of adsorption and the total amounts adsorbed. The salts used are potassium acid phosphate, magnesium acid phosphate and magnesium sulphate, with both iron and aluminum oxides.

The influence of hydrogen ion concentration on the adsorption of precipitating ions: HARRY B. WEISER and EVERETT E. PORTER. An investigation of adsorption during the precipitation of colloidal hydrous chromic oxide, at varying hydrogen ion concentrations. The adsorption of salt anions during the precipitation of gels stabilized by hydrogen ion is greater the greater the hydrogen ion concentration. However, the adsorption is appreciable even on the alkali side of the neutral point and is completely nullified only in the presence of an appreciable concentration of hydroxyl iron. The adsorption varies with different precipitating ions at the same hydrogen ion concentration and there is no indication of the formation of definite compounds. The most strongly adsorbed ion precipitates in lowest concentration, in accord with Freundlich's rule. It is probable that Loeb failed to observe the taking up of anions from neutral salts on the alkali side of the isoelectric point of gelatine because he worked with concentrations of salt anions which were too low relatively to that of hydroxyl.

The relation of pore size in silica gels to adsorption of gases and vapors: HARRY N. HOLMES and H. F. WEIDE. The authors found that in silica gels there is an optimum pore diameter corresponding to the maximum adsorption of a particular gas or vapor. A method was devised for preparing highly adsorbent gels with pores differing widely in average diameter. The adsorption of benzene, toluene, acetone, methyl alcohol, ethyl alcohol, acetic acid, methyl propionate and ethyl acetate at equal partial pressures was studied. With these substances molecular volume and critical temperature showed the greatest influence on adsorption.

[1] At — 45°, 0°, and 25°. Anomalous behavior of the cell.

Absolute unit of fluidity: EUGENE C. BINGHAM. The term *reciprocal poise* is not a satisfactory term for the absolute unit of fluidity. The term *rhe* is suggested. Since fluidities are referred to many different temperatures, it is desirable to take the fluidity of water at one temperature as standard. It is proposed that the fluidity of water at 20 degrees be taken for all calibration purposes at 100.5.

Colloid distribution and the capillary rise of sols: T. R. BRIGGS. The capillary rise of sols in filter paper has been studied from the point of view of the distribution of a suspended colloid between a liquid and a solid phase. Anything which peptizes the colloid acts against its adsorption by the paper and favors the capillary rise. Destabilizing agents favor adsorption by the paper and bring about a decrease in the capillary rise. The theory is general and applies to emulsification with finely divided solids and to the process of dyeing with the substantive or colloidal colors.

Colloid distribution and the theory of dyeing with substantive colors: T. R. BRIGGS. From a consideration of the general process of colloid distribution, a special theory of substantive dyeing has been formulated and tested by experiment. A substance which destabilizes the suspension of the dye will act as an assistant in the dyebath up to the point of actual flocculation. A substance which stabilizes the suspension of the dye will act as a restrainer, providing it does not act as a mordant toward fiber and dye. A stabilizing substance and a destabilizing substance may each exert their special effect in the same dyebath. Transition dyes undoubtedly exist which combine with their properties of acid or basic dyes the characteristics of substantive dyes.

The conductivity of suspensions: HUGO FRICKE and STERNE MORSE. One of us has developed the following formula for the conductivity of suspensions of spheroids in terms of the conductivities of the suspending liquid, suspended particles and the shape of the latter, on the assumption that the arrangement of the particles is fortuitous:

$$\frac{K - K_1}{K - K_2}\left(1 - \frac{K_2}{K_1}\right) = \beta\frac{\rho}{1-\rho}$$

where

K = conductivity of suspension

K_1 = conductivity of suspending liquid

K_2 = conductivity of suspended particles

ρ = volume concentration of suspended particles

$$\beta = \frac{1}{3}\left[\frac{2}{1 + \frac{(K_2 - 1)}{K_1}\sigma} + \frac{1}{1 + \frac{(K_2 - 1)(1 - \sigma)}{K_1}}\right]$$

$$\sigma = \int_0^\infty \frac{d\lambda}{\left(1 + \frac{b^2}{a^2}\lambda\right)^{\frac{1}{2}}(1 + \lambda)^2}$$

a = axis of rotation of spheroid

b = conjugate axis of spheroid.

Graphs for β are given for various values of $\frac{K_1}{K_2}$ and $\frac{a}{b}$. The formula has been tested by comparison with Stewart's values for the conductivity of suspensions of red blood corpuscles $\left(\frac{a}{b} = \frac{1}{4.25}\ K_2 = 0\right)$ with agreement to 1 per cent. or less, within the experimental error and with our own experimental data for cream $\left(\frac{a}{b} = 1, K_2 = 0\right)$ with about the same good agreement. The actual size of the particle does not enter in. The value of the shape appears only in the constant β which is not greatly changed by most combinations of $\frac{K_1}{K_2}$ and $\frac{a}{b}$. Graphs for β for various values of $\frac{K_1}{K_2}$ and $\frac{a}{b}$ are given.

The effect of hydrophilic colloids on the size and distribution of particles in electrolytic precipitation. III Macroscopic crystals from evaporation: DORMAN MCBURNEY and WESLEY G. FRANCE. The size of macroscopic crystals formed by evaporation in both the presence and absence of addition agents was studied with basic lead carbonate, using gelatin, tannin, agar-agar and egg albumen, in concentrations from 0 per cent. to 1 per cent. The addition of gelatin or egg albumen was accompanied by the formation of smaller crystals, and by an increase in the number of crystal groups. The samples to which agar-agar had been added showed clumps of crystals branching from a central nucleus. The presence of tannin seemed to inhibit the formation of well-defined crystals. (By title).

A new method for the separation of elements of the rare earths: JAMES KENDALL and BEVERLY L. CLARK. The ionic migration method previously proposed for the separation of isotopes (Proc. Nat. Acad. Sci., *9*, 75 (1923)) has been successfully extended to the fractionation of certain rare earth mixtures. A gel containing the given mixture is placed in a long glass tube, between a section of KCl gel (nearer the anode) and a section of chromic sulphate gel (nearer the cathode). On electrolysis, since the K^+ moves more rapidly than the rare earth ions, and the Cr^{+++} moves more slowly, the two boundaries of the central section remain quite sharp, even after it has travelled a long distance. If the rare earth ions themselves have appreciably different mobilities, the faster ion should accumulate in the front portion and the slower in the rear portion of this section so that a complete separation should readily be obtained. Short runs have been carried out with three mixtures: yttrium-erbium, gadolinium-samarium and neodymium-praseodymium. In the first two cases a 400 cm run gave practically perfect separation, in the last the separation was only partial.

The ammonium carbamate equilibrium: T. R. BRIGGS and V. MIGRDICHIAN. The system solid ammonium carbamate, ammonia and carbon dioxide has been reinvestigated from the point of view of the Mass Law, at temperatures between 10° and 45°, and in the presence of an excess of either one of the gaseous components. The dissociation pressure of ammonium carbamate has also been redetermined between these temperatures. The equilibrium has been found to conform very closely to the requirements of the Mass Law.

The detection of azeotropic mixtures: T. R. BRIGGS. A simple laboratory method of distinguishing between a chemical individual and an azeotropic or constant-boiling mixture has been devised and applied to the systems: hydrochloric acid-water and methyl alcohol-benzene. The method is based on the familiar principle that the azeotropic composition is displaced by a change of pressure. A complete cycle of distillation, reversible with respect of either the residue or the distillate, is described. The method is especially available as a simple and instructive experiment in a course in physical chemistry (By title).

The binary system, silver perchlorate-pyridine, and the ternary system, silver perchlorate-pyridine-water: RUDOLPH MACY. A phase rule study of the binary system has been made from the eutectic to temperatures above 100°, and the solubility curves of 3 molecular compounds determined. The compositions of these compounds were obtained from a study of the ternary system at 25°. They are $AgClO_4.4C_5H_5N$, $4AgClO_4.9C_5H_5N$, and $AgClO_4.2C_5H_5N$. Of these only the first compound was obtained in pure enough form for the composition to be checked by a direct analysis. A complete study of the ternary system was made at 25°.

Germanium tetraethyl: L. M. DENNIS and F. E. HANCE. Germanium tetraethyl was prepared by the interaction of zinc diethyl and germanium tetrachloride in an atmosphere of carbon dioxide, using an apparatus of special design. The compound was shown by analysis to correspond with the formula $Ge(C_2H_5)_4$. It is a colorless, oily liquid boiling at 163.5°, freezing at $-90° \pm 0.2°$, having a specific gravity of $0.9912\ \frac{24.5°}{24.5°}$ and a refractive index at 20° of 1.4000. It is insoluble in water, miscible in all proportions with ethyl alcohol, diethyl ether, benzene and some other organic solvents. It is not easily attacked by oxidizing agents and is stable in the air under ordinary conditions. It burns with a smoky flame, leaving a residue of the normal and lower oxides of germanium.

The physical properties of monogermane: ROBERT B. COREY. Monogermane, GeH_4, prepared as described in a previous investigation, was carefully purified. The density as gas, the density as liquid, the melting point and the boiling point of the compound were determined, and the tension-temperature curve was plotted. Vapor tension values quite different from those previously published by Schenck were obtained.

The behavior of anhydrous hydronitric acid toward various inorganic salts: A. E. MCKINNEY. A qualitative study of the behavior of anhydrous liquid hydrogen trinitride at 0° toward about 250 solid substances.

chiefly inorganic salts, has been made. It has been shown that this liquid acts as a dissociating solvent toward a large number of inorganic solutes, but shows little or no tendency to form solvates. In the case of certain inorganic salts solvolysis has been found to take place. Qualitative observations have been made on the behavior of the various salts during electrolysis.

Heavy metal azido-dithiocarbonates: G. B. L. SMITH and PAUL WARTMAN. Aqueous solutions of $HSCSN_3$ form insoluble precipitates with $AgNO_3$, $Hg_2(NO_3)_2$, $HgCl_2$, $AuCl_3$, $CuSO_4$, $ZnSO_4$, $Cd(C_2H_3O_2)_2$, Tl_2SO_4, $Pb(C_2H_3O_2)_2$, and $Bi(NO_3)_3$. Of these substances, the following have been identified by analysis, and their chemical and crystallographic properties studied: $AgSCSN_3$, $Cd(SCSN_3)_2.2H_2O$, $Hg(SCSN_3)_2$, $Hg_2(SCSN_3)_2$, $TlSCSN_3$ and $Pb(SCSN_3)_2$. The heavy metals of the first group of the periodic system as well as univalent mercury form amorphous or cheesy precipitates, which are probably highly hydrated. The heavy metals of the second, third and fourth groups form crystalline precipitates of well-defined structure. All these salts in the dry state are sensitive both to shock and heat. The crystalline substances are more or less sensitive to shock, not only in the dry state, but also in contact with the mother liquor. The violence of the explosion appears to be a function of the atomic weight of the basic ion, increasing with rising atomic weight.

Azido-dithiocarbonates of the alkali and alkaline earth metals: L. F. AUDRIETH. Aqueous solutions of alkali and alkaline earth trinitrides react with CS_2 to form the respective azido-dithiocarbonates. The following salts have been isolated, analyzed and identified, and their chemical and crystallographic properties have been studied: $LiSCSN_3.H_2O$, $NaCSN_3$, $NaSCSN_3.2H_2O$, $NaSCSN_3.4H_2O$, $KSCSN_3$, $RbSCSN_3$, $Ca(SCSN_3)_2.5H_2O$, $Sr(SCSN_3)_2.5H_2O$, $Ba(SCSN_3)_2.5H_2O$. Evidence has also been obtained of the existence of the compound $CsSCSN_3$. The K, Rb and probably Cs salts crystallize from aqueous solution in the anhydrous state, while the salts of the alkaline earth metals and of the two transition elements of Group I, Na and Li come out as hydrates. All these salts in the dry state are sensitive both to shock and heat. The violence of the explosion appears to be a function of the atomic weight of the basic ion increasing with rising atomic weight.

Standardization of sodium thiosulfate solution: STEPHEN POPOFF and J. L. WHITMAN. The study of equilibrium conditions between sodium thiosulfate and iodine was made the basis for the determination of the best conditions for the standardization of sodium thiosulfate by iodine, $KMnO_4$, $K_2Cr_2O_7$, $KBrO_3$ and Cu. The normalities of the thiosulfate checked to within 0.05 per cent., regardless of the standard used, except in the case of Cu. Maximum variation among the results was not more than 0.06 per cent. as compared with 0.3 per cent. by other investigators. This accuracy was made possible by the study of the equilibrium conditions, by employing the electrometric method in all titrations even in the standardization of $KMnO_4$ by $Na_2C_2O_4$ (in spite of the common statement that the latter was not possible) and by using a special form of apparatus for weighing the iodine.

Electrometric titrations in acidimetry and alkalimetry without the use of the hydrogen electrode: STEPHEN POPOFF and JOHN MCHENRY. Since the hydrogen electrode requires time to come to equilibrium with any solution, and since it is poisoned or influenced by some substances, platinum wire, especially treated, was made the basis of a study of both titrations in acidimetry and alkalimetry and actual determination of hydrogen ion. The results obtained are good and promising.

The determination of iron: STEPHEN POPOFF, CECIL POWELL and JOHN MCHENRY. The order of the addition of iron and ammonia solutions and the number of reprecipitations in the determination of iron in the presence of sulfates was studied. If double precipitation is used, the order of the addition of iron and ammonia makes no appreciable variation; if single precipitation only is resorted to, the results are low regardless of the order of the addition of reagents (By title).

A sensitive test for copper: STEPHEN POPOFF and CARL W. TUCKER. The use of potassium ferrocyanide as a test for copper in the electrolytic determination of that metal is hardly justifiable even in ordinary work. By substituting haemotoxylin and by using copper gauzes as cathodes and a special form of platinum anode, the accuracy is increased and the cost reduced to a minimum (By title).

A new design circuit breaker for laboratory thermostats: G. FREDERICK SMITH and C. E. HOLLISTER. A modified telegraphic relay presents difficulties as a working part of electrically heated laboratory thermostats. This article describes a device designed with the aim of eliminating these difficulties and fulfils the following qualifications: (1) The power contacts will continuously open and close a 100 watt heating load at 110 volts. (2) The use of condensers has been found unnecessary on voltages up to 110. (3) Springs are eliminated. (4) The magnetizing winding operates at low voltage with low current in order to minimize arching at the mercury contact of the toluene regulator. All dimensions and details of design together with photos and cross-section drawing of the device are given for the purposes of duplication. The apparatus has been thoroughly and favorably tested (By title).

Formation of mother of pearl: F. G. DONNAN. By allowing an aqueous solution of calcium bicarbonate containing gelatin to slowly evaporate, it is possible under suitable conditions to produce a deposition of calcium carbonate in a close Liesegang ring formation, which exhibits diffraction colors nad pearly luster, closely resembling natural mother of pearl in these respects.

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SCIENCE NEWS

AN ANCIENT MAYA CITY IN YUCATAN

Science Service

CHICHEN ITZA, a thriving Maya metropolis before the time of Columbus, but now a ruin shrouded by tropical forest, has begun to yield its secrets, as reported by Dr. Sylvanus G. Morley, leader of the archeological expedition of the Carnegie Institution of Washington, at this site in Yucatan, Mexico.

During the course of the excavations that inaugurated the ten-year program of research in cooperation with the Mexican government, an elaborate sculptural mosaic flanking a gateway into the "Court of he Thousand Columns" was discovered.

The part of the city chosen by the Carnegie Institution for its first excavations is the Group of the Thousand Columns, a large assemblage of temples, colonnaded halls and pyramids surrounding a great plaza of more than five acres in extent.

Chichen Itza, when it was a flourishing city of the "New" Maya Empire, about 1000 A. D., covered an immense extent. The civic and religious center, that part seen to-day, containing the temples, palaces, pyramids, market-places, ball-courts, terraces, tombs and plazas alone covers an area two miles long by a mile wide; but beyond this in every direction for miles and miles formerly stretched the houses of the humbler folk, with sides of saplings covered with white lime plaster and roofed with a thatch of the golden hued leaves of the guano palm. Of these not a trace may now be seen, the great forest of Yucatan has, one and all, laid them low, destroyed them, obliterated them, so that now they are as much a part of the earth as the thousands of Maya who reared them so long ago.

"The great plaza of the 'Group of the Thousand Columns' is bounded on its west and north sides by two long colonnaded halls," Dr. Morley's report says. "The south and east sides of this plaza are of a more complicated nature.

"The east side is dominated by a pyramid ascended by a broad stairway with the balustrades carved in the likeness of two great plumed serpents, Ku Kulcan, the Feathered Serpent, the patron deity of the city, the two immense heads carved from single blocks of stone with gaping mouths and protruding tongues, forming the two lower newel-posts of the stairway.

"Above, there is a magnificent temple with feathered serpent columns at the entrance and beautifully carved square columns on the inside. This pyramid-temple is flanked by colonnaded halls on both sides and other edifices with elaborate sculptures.

"Nor does the foregoing by any means exhaust the buildings of the Group of the Thousand Columns, for on every side there are flanking temples, pyramids, colonnaded halls, courts, platforms, terraces, etc., the whole of which vast architectural complex rises from an artificial platform, itself more than ten feet above the level of the surrounding country in some places, which covers more than 45 acres.

"Excavations were commenced on the two principal entrances to the great central plaza of this group, which has been named the Court of the Thousand Columns for obvious reasons.

"The principal entrance from the other parts of the city would appear to have been through a gateway in the West Colonnade. The gateway beneath the North Colonnade, however, proved of more interest.

"Both ends, it was found, had the same decoration. Flanking the northern end on the left side there is a jaguar crouching upon its haunches facing the gateway, with its forepaw extended and tongue lolling from its mouth. Flowers and scrolls surround this figure. The opposite, or right side, has a macaw with extended talons, flowers and scrolls again forming part of the decorative scheme. The southern end of the gateway has the same treatment.

"Directly above each end of the gateway there was a large round shield or disc divided into eight sections. The association of a jaguar and a shield recalls another edifice in the city, the famous Temple of the Jaguars, so named because of a frieze on it which represents a series of stalking jaguars alternating with round shields.

"It has been thought that an appropriate name for this entrance to the Court of the Thousand Columns might be 'The Jaguar and Macaw Gate.'"

THE EFFECT OF TEMPERATURE ON THE HUMAN BODY

Science Service

THAT the human body, in a state of rest and in still air, can not endure indefinitely a temperature higher than 90 degrees F. with 100 per cent. relative humidity has been determined by Department of the Interior investigators at the Pittsburgh experiment station of the Bureau of Mines, cooperating with the American Society of Heating and Ventilating Engineers. In the course of the tests, it was noted that the heavier and stouter men of the experiments, when subjected to uncomfortably hot temperatures, lost more weight than the lighter and thinner men, but as a rule could endure such temperatures for a longer period and complained less of the exhaustion which followed. Loss of weight in the subjects experimented with gradually increased with an increase in atmospheric temperature. Whenever the subject drank ice water he immediately gained in weight, and in all cases the subject, within 24 hours, usually regained the entire weight lost. Subjects who drank ice water freely after exposure to high temperatures felt no ill effects, tending to disprove the assumption that such action develops severe cramps.

It was found that the exhaustion and weakness following subjection of human beings to a very high temperature and humidity for a short period is not so severe as

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subjection to a moderately high temperature and humidity for a longer period.

The pulse rate, rather than the rise in body temperature, apparently determines the extent of the discomfort experienced by the subject. Subjects became very uncomfortable after the pulse rate exceeded 135 pulsations per minute, and complained of unbearable and distressing symptoms when the pulse exceeded 160 per minute. The highest pulse rate recorded was 184 per minute. Subjection to high temperatures and humidities produced no marked change in the respiratory rate.

The health, comfort and efficiency of men engaged in the mining industry may be impaired, in some instances very seriously, by abnormal physical conditions of the mine air or by variations in its composition. This is true in some of the metal mines of the west where high temperatures with varying humidities are encountered. Physiological studies have been made by the Bureau of Mines in some of these mines showing the effects of various temperatures and humidities. As it is difficult to carry out studies on many controlled temperatures, it was thought best to make the present experiments in a laboratory and apply the results to the mining industry insofar as practicable. The experiments were part of a general cooperative study of the physiological effects of heat and humidity being conducted by the Bureau of Mines and the United States Public Health Service, cooperating with the American Society of Heating and Ventilating Engineers, at the Bureau of Mines experiment station, Pittsburgh, Pennsylvania.

The experiments were conducted in two fully equipped chambers, insulated by cork board, designed to maintain air conditions at a desired temperature and humidity. The temperature, humidity and air motion of each room may be controlled independently of each other. The air conditions are controlled by apparatus outside of the chambers and entirely separated from them. Instruments for observing the body and surface temperatures of the subject, also for recording the rate of respiration and of heart pulsations, and the apparatus for basal metabolism work are located in an adjoining room.

THE AMERICAN GEOGRAPHICAL SOCIETY'S SCHOOL FOR EXPLORERS

Science Service

In order to produce explorers able to find where they are in a strange country and to accurately locate the finds which they make, the American Geographical Society of New York has established a school for explorers in that city. Specialized training in geographical surveying and field astronomy will be given.

"Exploring and surveying expeditions must obtain the services of surveyors with initiative, practical experience and all-around knowledge of the subject if they are to take full advantage of the time and money at their disposal," said Dr. Isaiah Bowman, director of the society, in explaining the purpose of the school.

"Such men should be able to make a simple compass traverse or accurate determinations of latitude and longitude with equal ease. They should be skilled in the art of sketching in detail on a plane table or in the execution of a triangulation in all its details, from the initial reconnaissance to the computing of the geographical coordinates of its trigonometrical stations.

"Not only must they be able to do these things, but they must be able to adapt themselves to whatever surrounding they find themselves in, and to choose the surveying methods most suitable to the occasion."

Dr. Hamilton Rice, the distinguished South American explorer, instigated the scheme and is director of the school. The whole course, which is comparable with post-graduate work at a university, should be accomplished in from a year to two years.

Individual instruction, practical work in the field and facilities to handle first-class and up-to-date instruments are features of the instructional methods of the school. Students begin the course at any time and may take all or any part of it.

The practical work in the field includes the mapping of an area of eight or nine hundred square miles on a scale of 1 : 125,000 or thereabouts. From the initial triangulation reconnaissance to the inking in of the finished map, all must be executed by the student himself. The area selected for mapping is the country on either side of the Hudson river between Dobbs Ferry and Newburgh, and for so small an area affords a great variety in topographical detail.

A NEW AIRPLANE CATAPULT

Science Service

A new type of airplane catapult in which a powder charge is used for giving the plane its initial start, instead of compressed air, has recently been tested by the U. S. Navy with satisfactory results.

In the new type, the catapult gun contains a piston which is connected through a series of multiple purchases or pulleys to a small wheeled car. The car on which the airplane is placed runs on tracks which are fifty feet long and are secured to a platform located on the top of a battleship turret. When the powder charge is fired in the gun, the piston, being forced to move, acts through the pulleys, thus pulling the car suddenly forward along the tracks at a speed of sixty miles per hour, carrying the plane with it.

When the car reaches the end of the track, it is stopped by means of hydraulic and spring buffers. The plane, with its engine going at full speed, is automatically released from the car and continues under its own power.

In the test made at the Naval Air Station a single seater scouting monoplane of the hydroplane type was used. The plane left the catapult car and continued its flight without any drop in altitude below the level of the tracks, which is unusual. This fact was particularly pleasing to the officials, since heretofore it has been necessary to have the tracks at such a height above the water that catapults were impracticable for several types of ships on which it was desired to have them installed.

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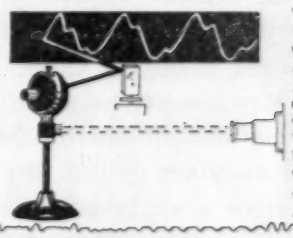

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All airplane carriers and other types of ships carrying airplanes will be equipped with the gun type catapult as soon as the Navy Department can build and install them.

FOSSIL DIATOMS AS AN AID TO THE LOCATION OF OIL

Science Service

OIL companies operating in the fields of southern California are making use of the fossil skeletons of diatoms, microscopic plants which lived in the oceans ages ago, to help them determine where they will find oil. These jewel-like fossils, each so small that it can only be seen through a microscope, are helping the drillers to locate the wealth of the vast underground pools of oil. Thousands of dollars have been saved through applying the knowledge gained by scientists concerning these ancient dwellers in the seas, according to a geologist working with one of the oil companies.

Southern California is rich in deposits of diatom skeletons which have accumulated during many geologic periods, and diatoms are still living in countless numbers in all the seas and lakes and rivers from the North Pole to the South Pole. The deposits often cover several square miles of surface and are in some cases hundreds of feet thick. The diatom, although only a one-celled plant, has, like other plants and animals, developed many new species, numbering over 7,000, because their environment of land and sea, the water depth, temperature and chemical composition of the salts in the water all have had their effect. Consequently the diatom deposits write geological history.

It is this fact which the geologist has learned to put to profitable use in southern California; for by studying the form and structure of these minute fossils he can often tell the oil men just about how far their drills are from the precious oil-bearing sand or whether they are above or below it. The position of the oil sand has a definite relation to that of the other geological formations which frequently may be identified by a microscopical examination of the diatoms and other minute fossils found in them.

Because of the value to the oil business of this knowledge of diatoms in the formations through which the oil wells are drilled, the oil companies are cooperating to further a study of these minute fossils, each a jewel-like shell of silica which ages ago incased its tiny one-celled occupant. Seen under the microscope they are among the most beautiful objects in nature, yet they are of great practical value, not only to the oil companies, but in other ways. Diatomaceous earth, as the deposits of their accumulated skeletons is called, is put to many valuable uses.

But diatoms do not have to be dead a million years to be of use. They are the chief vegetations of the sea upon which ultimately depends the life of all the creatures therein, many of which are in their turn valuable food for man. They still live in countless numbers in the seas and lakes and streams and alive or dead they have their use. Those which died millions of years ago are now one of the most valued aids to the world of today in locating new sources of energy, secured, not by eating the diatoms or the animal life that feeds upon them, but by burning the oil to which they are such a helpful index and which, like them, has laid dormant under the earth for ages of time.

ITEMS

Science Service

AN Arctic expedition largely undertaken by Oxford University is about to start on an exploration of North Eastland, a large island, 90 miles square, which lies to the northeast of Spitzbergen. Two previous attempts have been made to explore it. The first in 1873 was by the Norwegian, Nordenskiold, and was only partially successful. A German expedition in 1912 perished in the attempt.

DETERMINATION of the amount of carbon dioxide gas in the flue gases from blast furnaces is an important method of furnace control, but it has always been a difficult job to get samples of the hot gases for analysis. A German firm has now invented a method of using electricity to make continuous analyses of the flowing gas. Different gases have differing powers of heat transmission. Electrically heated wires are passed through an air chamber and through one filled with flue gases. Electrical resistance of the wires changes with the temperature, and since the relative heat losses measure the amount of carbon dioxide in the flue gas, that percentage can be easily measured by determination of the electrical resistance.

WHY are some woods more durable than others? That is a question which has apparently been answered for the first time by investigators at the Forest Service laboratory at Madison, Wisconsin. They have found that woods that endure contain substances that when extracted by water are poisonous to the forms of bacteria and wood-destroying fungi responsible for wood decay. These toxic substances are more abundant in the heartwood than in the sapwood, explaining the superior durability of wood taken from that part of the tree. The presence of these substances in the wood prevents the growth of the organisms which, if unchecked, would rapidly destroy it.

THE first application in America of the process for hardening railway rails after they have been laid is reported from Toronto, according to the *Electric Railway Journal*. A blowpipe is mounted on wheels and passed over the surface of the rail at a speed that gives a temperature of 850 degrees Centigrade to all points heated. Immediately after heating, a jet of water is played upon the rail, the effect being to harden the surface and prolong its wearing qualities. The process is effective to a depth of from two to three tenths of an inch, according to the pressure used in the blowpipe.

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SCIENCE NEWS

THE AGE AND DEPTH OF MINES

Department of the Interior

OLD mines are not very deep and deep mines are not very old, on the average, according to Dr. Thomas T. Read, acting assistant to the director of the Bureau of Mines, Department of the Interior, in a recent statement on the deep mines of the world.

The oldest mines in the world of which there is any certain record are the copper and turquoise mines of the Sinai Peninsula, which were worked by the Egyptians as early as 3700 B. C., but these have never been sunk to what would now be considered even moderate depths. The silver-lead mines of Mount Laurion, in Greece, are very old. Xenophon, writing in 355 B. C., said, "They were wrought in very ancient times," but, as the mineral occurs along the contact between approximately horizontal limestones and slates, it is hardly possible to speak of the mines as having any depth at all, except in the sense that a tunnel has depth beneath the top of the mountain it pierces. The Phoenicians probably began to work the tin mines of Spain and Cornwall as early as 1500 B. C. Although tin mining in Cornwall has been carried on continuously until modern times, the Dolcoath workings, the deepest, were not sunk further than 3,300 feet, as the cost of tin produced from such depth was too great to compete with that from surface workings in Malaysia.

The various other mines in Europe are not very deep. The Sulitelma mine, in Norway, has an inclined shaft 3,700 feet deep, and is of particular interest because it is the only deep mine north of the Arctic Circle; it was opened in 1887. Generally speaking, the deepest mines of Europe are coal mines. Coal mine shafts in Great Britain are as much as 3,500 feet deep, while many of the coal mine shafts in Belgium and France are over 3,000 feet deep and several shafts are now being sunk which will go to a depth of 4,000 feet.

Most of the mines of South America might more accurately be called high rather than deep. The Braden mine, in Chile, one of the big copper mines opened in recent times, is entered at the bottom and worked up. The copper mines at Cerro de Pasco, in Peru (started as a silver mine in 1630), are only about 1,000 feet deep, though they are at an elevation of 14,000 feet above sea level. There are some small mines in South America at even greater elevations than this, but the only really deep mine in South America is the St. John del Rey mine in Brazil; which is the deepest mine in the world. Its workings extend to a depth of 6,726 feet vertically below the top of the main shaft. This depth is reached by a series of connected shafts, like a flight of stairs. This is a gold mine which was started in 1834, and the region in which it is situated is the oldest mining region in the New World, gold having been continuously mined there for well over two hundred years.

The gold mines of the Transvaal, South Africa, take second highest rank for depth. The Village Deep workings extend to a depth of 6,263 feet, and there are so many mines of which the workings are over 4,000 feet in depth that it would make too long a list to mention them. The City Deep has made plans to work to a depth of 7,000 feet.

Australia has many mines and some of them are quite deep, the Victoria Consolidated, at Bendigo, being over 4,600 feet deep, and the New Chum is over 4,100 feet deep. At Kalgoorlie, in Western Australia, there are several mines from 2,000 to over 3,000 feet deep.

The deepest mine workings in the United States are those of the Calumet and Hecla Consolidated, on the Keeweenaw Peninsula, Michigan. The copper deposits are inclined and the deepest workings are 5,990 feet vertically below the surface. The deepest vertical shaft is the Tamarack No. 5, 5,309 feet deep; the Red Jacket vertical shaft is 4,900 feet deep. There are several inclined shafts in this district which are over 8,000 feet long, but vertically they are not so deep as those mentioned. The deepest workings of the Calumet and Hecla represent the nearest approach man has made to the center of the earth, since they are about 4,600 feet below sea level. The other deep mines of the world are at higher elevations and consequently do not go so far below sea level. The deepest gold mine in the United States is in California, where the Kennedy Mining and Milling Company has a vertical shaft 4,200 feet deep. The Argonaut Mining Company, nearby, has a shaft, inclined at 60°, which is 4,850 feet long. None of the coal mines in the United States is notably deep; one mine in Illinois has a shaft 1,004 feet deep.

Holes have been bored much deeper into the earth than mine workings have penetrated, but no one has, of course, ever been to the bottom of such holes. The deepest hole in the earth is in West Virginia, where it was bored to a depth of 7,579 feet in search of natural gas.

THE SWEDISH ARCHEOLOGICAL EXPEDITION

Science Service

CROWN PRINCE GUSTAF ADOLF, heading the Swedish archeological expedition which is excavating the ancient city of Asine, Greece, has unearthed evidence that the so-called saddle-roof was known in Greece more than 3,000 years ago. The architecture of that Mycenean or pre-Hellenic period, is partly illustrated by fragments and ruins found at Mycenae. It has long been a question whether these houses had flat or sloping roofs, but word has just come from Greece that the Swedes at Asine have discovered and explored a tomb, which no one has entered or disturbed for 3,000 years, and have found that this tomb is in the shape of a house about 24 feet square cut into the rock, with the top cut into the exact form of a saddle-roof, with two sloping sides and gables at the ends.

The Crown Prince's expedition, which has now been at work a number of years, has just completed the

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spring term of excavation, and is returning to Sweden in order to make a scientific study of the treasures found. Up to date, more than 500,000 important treasures and fragments have been found, which are being classified and studied at Lund University by special permission of the Greek government, to which the bulk of the finds must eventually be returned. The finds include decorated vases, funeral urns, gold ornaments, silver and copper coins, etc., which illustrate the civilization and art during thousands of years of history in Asine. This city, situated on the Greek Peloponnesus, flourished and fell a number of times during the pre-Christian era. And a discovery just made by the Swedish expedition points to a surprising gap in its history. The excavators, after having cleared the strata which contained relics dating to about 300 B. C., found that the level directly beneath this contained a layer of relics undoubtedly belonging to a period about 1600 B. C. The scientists are now hoping that other excavations may throw some light on what had happened during the intervening 1,300 years.

One of the most important discoveries made at Asine this year is that of a house which expert archeologists from other countries pronounce the first house of the geometric period thus far excavated. A description of this house is, however, not now available.

The Swedish expedition will resume its field work in the autumn of this year.

A HEALTH STUDY OF SWEDEN

Science Service

THE complete investigation of personal health records extending back through several generations and covering a whole nation has been undertaken by the Swedish Institute of Racial Biology, the first government institution of its kind in the world, which has just turned in the report of the second year of its work.

Under Professor H. Lundborg, who organized the institute, anthropological statistics have now been gathered concerning 83,427 persons. Stature, head measurements, color of eyes and hair, diseases, especially hereditary diseases, causes of death, etc., are among the things observed by the investigators. In the northern provinces of Sweden, where Lapps, Finns and Swedes have intermarried, the death rate is relatively high. Special genealogical studies have, therefore, been undertaken in this region in order to ascertain, if possible, what effect race mixture has on longevity. In three villages, for example, genealogical histories have been drawn up for the entire population covering a period of 125 years. In another community the histories of 1,200 families have been traced during the period 1781–1851. Another subject that at present occupies the attention of Professor Lundborg and his assistants is the ancestral history of twins and triplets. During last year the genealogies of 137 pairs of twins were drawn up and studied.

Research into the histories of families is greatly facilitated by the unusually accurate parish registers which have been kept and preserved for hundreds of years, and also by the fact that the entire history of any given family is usually confined to Sweden. There has been almost no increase of the population through immigration, and the Swedes are said to have preserved greater racial purity than any other Teutonic people. Incidentally, it is shown by archeology that the history of the present inhabitants of Sweden goes back 5,000 years in the same place.

The accumulation of data regarding hereditary disease, the development of criminal instincts, and other traits is only a part of the program of the Swedish Institute of Racial Biology. It is also conducting research work into the elimination of racial taints through eugenic measures. Research is also being directed into the field of eugenics and the development of individual talent and genius.

ITEMS

Science Service

THE Kaibab National Forest, on the northern rim of the Grand Canyon of the Colorado, is threatened by a small beetle, just about a quarter of an inch long. This creature is known only by his scientific name of *Dendroctonus ponderosa*, but he is famous as a destroyer of trees. The Kaibab forest contains two billion feet of standing timber and is one of the greatest game preserves in the country, extending 25 miles along the canyon rim. The U. S. Forest Service has declared war on the beetle, and with the Bureau of Entomology proposes to spend $25,000 this summer in a campaign of extermination.

ON one of those lonely island specks in the largest of oceans, known as the Hawaiian Bird Reservation, is a peculiar species of teal which has lost the power of flight. This wild duck can be easily run down by a man on foot. But as men do not come to his island once in a blue moon it would seem safe. However, it has to have fresh water and the only fresh water on the almost barren island is a small pool. Should the encroaching sands cover the pool, which seems likely, this rare flightless duck must die.

THE world's largest direct current high-voltage generator has been developed by S. R. Bergman, consulting engineer of the General Electric Company at Schenectady, and is expected to make clearer the programs broadcast long distances by radio. It is also claimed that by the use of this machine for electric railroad work the number of sub-stations now required can be reduced one half. Rectified high voltage alternating current is now used for distance broadcasting. Rectifying alternating current, however, produces ripples which affect the clearness of the transmitted sound. Direct current generators give current that is perfectly smooth.

AN unusual occurrence of ice in the North Pacific has been reported to the U. S. Hydrographic Office by the master of the American steamer, "West Jessup," who relates having seen "a large and a small piece of drift ice" in latitude 41 degrees 38 minutes north, and longitude 144 degrees, 2 minutes east. This is about 100 miles off the coast of Japan.

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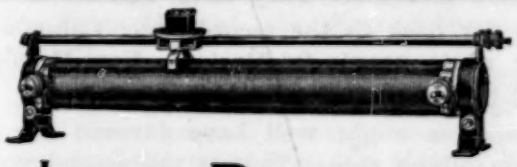

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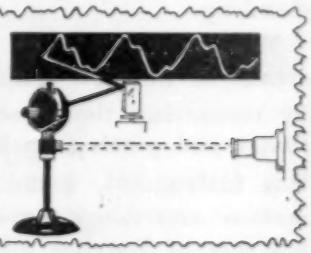

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SCIENCE NEWS

OCEANOGRAPHIC SURVEY BY THE HYDROGRAPHIC OFFICE

Science Service

PLANS for the most complete survey of the ocean from top to bottom ever attempted have been inaugurated by a conference representing scientific branches of the government and allied institutions held at Washington under the auspices of the Hydrographic Office of the U. S. Navy.

Definite routes and areas have not yet been chosen, but the preliminary discussion indicates that instead of a globe-girdling expedition, a comparatively small section of the seas will be selected for intensive study. The Aleutian Islands region of Bering Sea and the Caribbean Sea are under consideration as offering unusual opportunities for scientific investigation, with the latter most favored.

One or more ships will probably be fitted out with a complete laboratory and equipped with the latest scientific apparatus for the first cruise. The sea bottom will not only be mapped, but the composition of the water, its density, temperature and currents which affect the distribution of marine plant and animal life will be studied at all depths. Beside the investigation of the water and the life in it, specialists in various sciences will probably be landed on oceanic islands within the area covered by the ship.

In emphasizing the importance of this investigation, it was pointed out that five sevenths of the surface of our globe is covered by the waters of the seas. This water area can produce far more food than all the land can ever be made to yield, and one of the purposes of the expedition will probably be to take an inventory of such food possibilities which will be needed if our population continues to increase. Fish, mollusks and marine animals are dependent upon the microscopic plants that grow in the sea as far down as the sunlight penetrates. The floating mass of minute forms of vegetable and animal life, collectively called "plankton," varies greatly with slight changes in the temperature and composition of the sea water, according to laws not yet discovered, but which the proposed expedition may aid in understanding.

The exploring ship will map the ocean bottom by means of the new sonic finder which determines depths by measuring the lapsed time between sending down a sound and getting back the echo from the bottom. By this instrument, soundings can be made by a ship in motion and much more easily and quickly than by the old way of heaving the lead.

"WHITE INDIANS"

Science Service

So very little is known of the working of the laws of heredity among albinos that an opportunity to study a whole community of these strange human beings is exceedingly alluring to anthropologists. Dr. Clark Wissler, curator of anthropology of the American Museum of Natural History, says that the colonies of "White Indians," discovered along a tributary of the Chucunaque River in Panama by the Richard O. Marsh expedition, should prove to be a sort of laboratory.

Dr. Wissler inclines to the opinion that albinism will account for these human puzzles, who are arousing keen interest in New York City, where they have just arrived. Other anthropologists, however, point out that albinism would not explain the fact that they are round-headed, large-headed and large-boned, unlike other Indians of the San Blas tribes. Indeed, this is the one inexplicable thing about the new arrivals. Their skeletal peculiarities have led to many ingenious attempts to supply them with a history.

All the anthropologists agree that they can not be half-breeds. The crossing of dark with light races results in a smooth-toned skin, of whatever shade, and not in "this inhuman complexion," as Dr. Wissler calls it. To compare these white Indians with Swedes or other northern races is most unobservant, since the latter have ruddy and pronounced coloring, not a spectral pallor.

What, then, are the other possibilities? First, that they may be a separate and ancient race. Of this the anthropologists are skeptical. They recall, however, that in Central America as in Mexico the legend of a "white redeemer" who once dwelt among the people and would some day return, is common. Also it must be remembered that "white Indians" are the subject of old and authoritative mention. They have existed in the Zuni pueblo as far back as the records go. Columbus wrote of seeing white people in Darien. Von Humboldt related that they were to be found in Panama.

Circumstances might well have favored the development of an albino race. That is the second possibility, and the one best supported by known facts. The white Indians have always been ostracized by their San Blas neighbors, who fear racial contamination and drive them off into the jungle. The enforced segregation might easily have perpetuated albino traits. But then the skeletal differences remain to be accounted for. They also mar the third possibility, suggested by a scientist who has studied native African races—that these white Indians may be affected by a disease which prevents the nerves from supplying coloring matter (melanin) to the skin, hair and iris of the eyes.

THE ARMY WORM OUTBREAK

Science Service

THE outbreak of the army worm in Illinois has been brought under control, according to Professor George A. Dean, of the U. S. Department of Agriculture, who declared that the pest will not prove as damaging as was feared, not reaching the extent or severity of the attack ten years ago. A similar outbreak in Iowa is reported by W. P. Flint, state entomologist of Iowa, to have been checked before it got well under way.

This caterpillar of an insignificant moth or "miller" has been represented as moving very rapidly over several

SCHOOL AND SOCIETY

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The Relation of Educational Sociology to Educational Psychology: E. GEORGE PAYNE.

India in the Movement for World Education: RAJARAM VINAYAK GOGATE.

Educational Events:

Summer Vacation Courses at Geneva and Lausanne Universities; The Summer School of the National University of Mexico; The Summer School of the University of Cincinnati; Forestry Courses in the Summer School of Cornell University; Retirement Allowances for Massachusetts Teachers; The Washington Teachers' Salary Bill; A Tribute to Dr. W. L. Ettinger; The George F. Baker Foundation of the Harvard Graduate School of Business Administration.

Educational Notes and News.

Special Correspondence: The Centennial of the University of Indiana: FRANK R. ELLIOTT.

Discussion: The Carnegie Foundation and Reaction: HUBERT MCNEILL POTEAT.

Quotations: A Professorial Fiasco.

Societies and Meetings: The Washington Meeting of the National Education Association.

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A New Method of Measuring Character Traits: FRANK K. SHUTTLEWORTH.

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The Economics of the New Education: JOHN ADAMS.

Articulation of Colleges and Secondary Schools, with Respect to College Admissions: R. A. KENT.

Recent Developments in the Junior College Situation in California: WILLIAM MARTIN PROCTOR.

Educational Events:

The Section of Education of the British Association; The Educational Situation in Ireland; Budgets of German Universities; School Attendance in Mexico; Standards for Teacher Training Institutions; Courses for Connecticut Teachers at Yale University; The Award of Fellowships at Yale University; The Presidency of Clark University.

Educational Notes and News.

Special Correspondence: The Cleveland Educational Research Club: GARRY CLEVELAND MYERS.

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The Intersectional and Post-season Battle as a Menace to Athletic Games: HAROLD W. WHICKER.

Quotations: The Child-labor Amendment.

Societies and Meetings:

The Boston Branch of the American Association of University Women: ALICE W. COLLINS.

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A Method of Making Comparable Surveys of School Achievement: M. J. VAN WAGENEN.

JUNE 21, 1924

College Preparation for the Study of Medicine: B. C. H. HARVEY.

A Junior High School Art Program: LEON L. WINSLOW.

A Senior High School Course in Citizenship for Young Americans: MILTON BENNION.

Educational Events:

Intellectual Currents in Germany To-day; Student Travel for Foreign Service Training; A Conference on Schools and Delinquency; Public Health Summer Schools; The Brookwood Trade Union Summer School.

Educational Notes and News.

Discussion:

What Does Clinic Mean? JOHN M. BREWER.

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Education in the Free State and in Northern Ireland.

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The American Association of University Women: ISABELLE BRONK.

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The Relation of I. Q. to the Prognosis of Special Class Pupils: AUGUST DVORAK.

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The Place of Museum Education in a Total Scheme of Educational Objectives: DAVID SNEDDEN.

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Credit for Evening Work: C. S. MARSH.

Educational Events:

The Washington Program of the National Education Association; Research Work at the Fogg Art Museum; President Neilson's Report; National Organization of Chemical Education; Sympathy and the Certification of Teachers; Negro Communities in Tide-water Virginia; A New School of Business at Michigan; Medical College Consolidation at Chicago; Extension Courses for Teachers of the University of Missouri; Conservation of Eyesight and Industrial Accidents.

Educational Notes and News.

Special Correspondence:

How the Dillon Public Schools Cooperate with the College: LINDEN MCCULLOUGH.

Discussion:

The Relative Value of Laboratory Instruction: ELLIOT R. DOWNING.

Quotations:

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counties when in full action. An army worm has been known, according to Professor Dean, to cross an 80 acre field, a distance of one fourth of a mile, in 24 hours, which may be regarded as rapid for a caterpillar. But as the length of life of an army worm is from seven to ten days, depending upon the temperature, the distance an "army" can travel is limited. The distance a worm army travels depends largely upon the amount of food it finds. If, upon emerging from the eggs, the worms find only a thin covering of vegetation, the urge of hunger will compel migration and they will turn to grasses, young wheat, alfalfa and other tender plants. If there is sufficient food to carry them through the worm or caterpillar stage, they travel no farther.

The rapidity with which a field may be devoured is surprising. Professor Dean recalled a farmer who woke to find his 60-acre potato field of the night before a barren waste. There are many records of fields of wheat, corn and alfalfa disappearing between sunrise and sunset.

The worms undergo metamorphosis in the ground or under such shelter as they can find. The moths then emerge and fly considerable distances, and, by laying their eggs, prepare the way for another army worm outbreak. An army worm attack seems sudden because the extremely small young eat comparatively little and remain near the ground. With increasing size their appetite grows rapidly and their migratory search for food suddenly reveals their presence.

The last attack preceding the current army-worm attack in Illinois and Iowa occurred in each case ten years ago. The cold backward spring caused entomologists to expect the present attack.

THE ARTIFICIAL KIDNEY

Science Service

AN artificial kidney invented by Dr. John J. Abel, professor of pharmacology at the Medical School of Johns Hopkins University, is shortly to be tested on human beings according to word received by him from a German scientific man. Before Dr. Abel's discovery could be applied at the Johns Hopkins Hospital the war broke out and disorganized the source of supply of hirudin, an extract from Hungarian leeches necessary to the operation of the artificial kidney.

Dr. Abel's researches resulted in the discovery of the pure principle of adrenalin, and recently he and his collaborators, Drs. Chas. A. Rouiller and E. M. K. Geiling, have isolated a very powerfully acting hormone from the pituitary gland, an organ controlling the functions of growth.

To the uninitiated eye the artificial kidney looks very much as though it had been built after the general design of a steam boiler, but in reality it is made in imitation of the filtering mechanism in the kidneys of higher animals which is known as the glomerulus. On the interior of the artificial kidney are tubes of celloidin, a substance that lets the impurities and poisons strain through but retains in the blood the vital corpuscles and proteins. The leech extract, hirudin, is used to keep the blood from clotting as it flows through the tubes.

The apparatus is attached outside the body to an artery and the blood flows back again to another connection further along on the artery or to a vein. Any filterable constituent of the blood which must not be removed, such as blood sugar, is prevented from escaping through the walls of the celloidin tubes by the fact that they are submerged in a solution that contains the same amount of this substance as the blood.

Already the kidney has been tested on dogs with the result that it was found to operate so rapidly and efficiently that the living kidneys did not secrete and were relieved of their work so they could rest. The hope of applying it to the relief of human suffering lies chiefly in the field of cases where the kidneys break down in fatal cases of acute nephritis, scarlet fever, corrosive sublimate poisoning and similar toxic states. In many instances the life of the patient probably could be saved if his inflamed kidneys were given a few hours rest each day by artificial means.

ITEMS

Science Service

ANIMALS and plants while living give off rays similar to those emitted by the metal radium, according to reports made to the French Academy of Sciences by Albert Nodon. In his most recent experiments he used three photographic plates, placing on one of them a particle of a radioactive mineral, on another a living insect, and on the third plate a green leaf. A coarse cloth was laid between the object and the emulsion side of the plate. On developing the plates he found that not only had the mineral made a strong impression but that the insect had made a weaker impression and the leaf a slight impression. He calculates that the insect has a radioactivity per unit of weight from 8 to 13 times that of the uranium standard of radioactivity, and the green leaf 2 to 3 times. Dead organisms, on the contrary, exhibit no appreciable radioactivity, and M. Nodon concludes that radioactivity due to decomposition of atoms is a common accompaniment of living processes and may be regarded as a measure of the degree of vitality. On the contrary, Daniel Berthelot reported to the French Academy of Sciences that many experiments were made in 1909–10 to discover if plants and animals were radioactive, but no such effect was found.

THE maidenhair tree, introduced into America and Europe from China and Japan, but now not known to be growing wild anywhere, is the only survivor of an extensive family of prehistoric plants. It grows to be 100 feet tall and has leaves like the maidenhair fern. The most unique thing about it, however, is the way it gets its start in life. The flowers appear in April or early May and the pollen is distributed to the female flower. But sometimes the embryo is not formed until the seed has become full grown and fallen to the ground.

GREAT BRITAIN has $489,000,000 invested in rubber plantations. Holland has $130,000,000; Japan $40,000,000; while the United States, which uses three quarters of the world's rubber, has only $32,000,000 in plantations.

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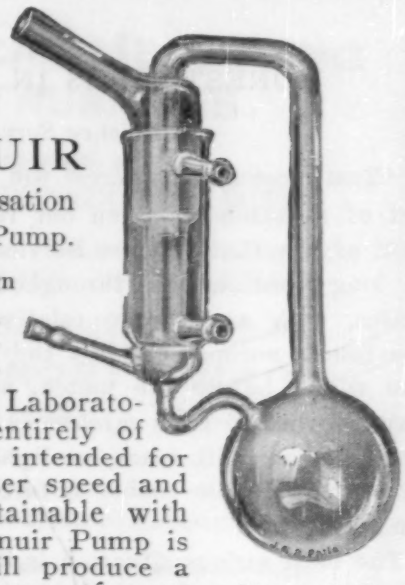

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SCIENCE NEWS

FOREST FIRES IN THE WEST

Science Service

"THE most serious forest fire year on record" is the gist of a statement given out recently by Miller Hamilton of the U. S. Forest Service. An extreme drought of long continuation throughout the western United States, with an average relative humidity only about one fourth normal, has left the forest lands everywhere like tinder before the match, and any kind of a fire started, whether from careless campfire or cigarette, locomotive or sawmill spark, or lightning, sweeps out great tracts of valuable timber before fire fighters can reach the scene.

The most serious situation is in California, where over 45,000 acres of timber in the national forests have already been destroyed. The burned areas are scattered throughout the state, from near Los Angeles to north of San Francisco bay, and from the high Sierras to the coast. One of the most notable fires was one that broke out near the town of Badger, and sweeping a path over six miles long and two or three miles wide, four times threatened to invade General Grant National Park, where some of the most venerable sequoias in the world are situated, and also Redwood Mountain, the region of the University of California big-tree tract. On account of the extreme dryness this fire traveled three miles in one and one half hours.

The fires in California have been due largely to the carelessness of tourists, campers and sawmill engineers, and to sparks from railroad engines. Newspapers, ministers, teachers and all civic bodies have been called upon by the Forest Service to preach the gospel of safety first, and certain threatened areas have been temporarily closed to campers until the danger shall have abated.

Elsewhere in the West the fire situation is quite as serious. In the national forests surrounding Yellowstone Park there have been 282 fires so far this summer, most of these due to lightning. In the Arapahoe forest, near Denver, a fire swept over five square miles in three hours, in spite of the fact that a force of fire fighters were on the lines within ten minutes after it started.

The Forest Service has 1,450 extra men on its payroll this summer on account of the fire situation, and has had as many as 300 actually on the fire lines at a given time.

"BLACK LILIES"

Science Service

"BLACK LILIES" for American flower gardens are a possibility of the future.

The Bureau of Plant Industry of the Department of Agriculture will experiment with seeds of a small lily ten to twelve inches high which grows in the Alpine Meadows of the Sila Pass in China at an altitude of about 12,000 feet. It is described by the bureau as "well worthy of cultivation on account of its drooping, rich, purplish black, bell-shaped flowers tinged with carmine which are one or two inches long and broad." This species was collected by J. F. Rock, collaborator for the bureau, during his recent exploration of the Yunnan province of China.

The introduction of a number of other promising flowers and decorative shrubs for the American flower lover is announced by the bureau this month. All these, of course, merely are subjects for experimentation at present and may not succeed under the conditions they must contend with in the United States.

Seeds have been received of the *Corokia virgata*, a slender branched shrub, six to twelve feet high, native of the most northern part of New Zealand where mild weather prevails. The shining green leaves are downy white underneath and yellow blossoms, about half an inch across, are borne in three-flowered clusters. It is a lawn possibility for the Southern states.

Experiments also will be conducted with a slender-branched, shrubby honeysuckle from Yunnan, China. The yellowish white flowers are marked with red and are followed by bright red berries.

From the mountains of western China also come the seeds of a climbing shrub, *Schizandra rubiflora*, which often reaches a height of twenty feet, with solitary dark red flowers about an inch across.

The Honorable Vicary Gibbs, of England, who forwarded the seeds of these three last-named shrubs to the department, has also sent the seeds of two species of viburnum. The first is a hardy, ornamental shrub about seven feet high, from the mountainous country of Western China with narrow, toothed, metallic green leaves, white flowers in lax panicles, followed by small red berries. The second is from Japan, similar in appearance to its companion, but with a higher growth.

The bureau plans efforts to make more popular in the United States the famous Mexican tiger flower, *Tigridia pavonia*, and has secured a large quantity of seed which will be grown in the greenhouses at Bell, Md. It is a bulbous plant adapted for mass planting. Although the individual blooms last but a short time the mass planting produces a succession of yellow, orange, scarlet and red flowers which are very striking. It is similar to the gladiolus and as easily grown.

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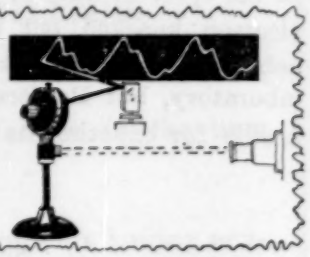

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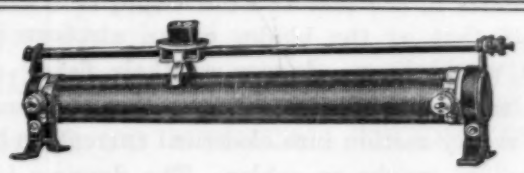

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blades. The new French type has only two blades but these are made much longer. The plans contemplate windmills with two blades revolving in a circle 100 or 130 feet in diameter.

In the last number of the French scientific journal, *La Nature*, Constantin, leader of the syndicate of engineers who have been studying the question of wind power since 1907, calculates that the hundred-foot windmill in a 13-mile wind will give 50 horse-power, and the 130-foot windmill will give 90 horse-power. With a wind of 22 miles an hour the smaller wheel will give 240 and the larger 400 horse-power. Constantin proposes to install a series of 130-foot windmills on Mont Ventoux, five thousand feet above the sea, and figures out that a single machine would deliver an average of over 700 horse-power throughout the year. The velocity at the extremity of the blades in the fastest wind would still not be more than half that of the blades of an airplane propeller, so there would be no danger of their flying off. The wheel is to be connected directly with a dynamo to convert the rotary motion into electrical current and do away with gearing, cranks or cables. The dynamo is encased in a light shell constructed on stream lines like a fish, so as to offer the least resistance to the wind. The wheel and dynamo turn on a common axis as the wind shifts.

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It is anticipated that the power thus derived from the wasted energy of the air may serve to warm houses, run shops, drive shop machinery, heat metallurgical furnaces and run trains. It is also planned to use windpower to propel vessels against the wind. Constantin and Joessel equipped a five-ton boat, the *Bois-Rose*, with a thirty-foot air screw, connected with a forty-two-inch marine propeller, and navigated this vessel on the Seine, at Paris, in all directions without disturbing the ordinary traffic. The vessel made about four and a half miles an hour in the face of a fifteen-mile wind.

"NEBULIUM"

Science Service

THE mystery of nebulium, the strange gas supposed to exist in comets, neublae and certain stars is being dissipated. Professor Harvey B. Lemon, of the University of Chicago, has made discoveries which indicate that there is probably no such element in the universe and what has been taken for it is merely helium in disguise.

Spectroscopists, who detect the make-up of stars and other things by analyzing the light which comes from them, have long been worried by lines in the nebular spectra, which did not agree with those of any substance known on earth. A bright green line was especially characteristic. These strange lines have been attributed to an unknown element of light atomic weight which was called "nebulium" after the nebulae in which they were found. Ideas about nebulium have, however, become even more nebulous, for modern work in physics and chemistry seems to indicate that there could be no light weight element not already known.

In addition to the so-called nebulium lines, most of the nebulae show the well known lines characteristic of hydrogen and helium. Thinking that one or both of these elements might possibly cause the lines of nebulium, Professor Lemon applied to them the algebraic formulae which had been found to fit the lines of many other spectra. According to his mathematics, the unknown nebular lines attributed to nebulium lie on the same parabolic curves as the spectral lines of a helium atom which has had one electron knocked out of it. The reproduction of the nebulium lines has never yet been accomplished in the laboratory, but Professor Lemon thinks his figures give a clue for experiments which may prove fruitful.

ITEMS

Science Service

ANNOUNCEMENT of a practicable generator for fluorine, the most active of all chemical elements, has been made by Dr. J. H. Hildebrand, of the University of California. The method involves the electrolysis of fused potassium bifluoride, one electrode being of graphite, the other consisting of the copper container. The gas is purified by passing through copper tubes filled with sodium fluoride, which removes the hydrogen fluoride. Fluorine is a gas at ordinary temperatures, and has such a power of grabbing up electrons that it can displace even the energetic oxygen and chlorine atoms from their compounds. Hitherto it has been difficult to prepare in quantity, and a larger supply will help in the solution of important chemical problems relating to the architecture of atoms.

FOR the preservation of the only two herds of wood bison known to exist in a wild state, the Canadian government has set aside an area of 5,000 square miles in the wilderness south of Great Slave Lake. Little had been known of these herds of wild wood bison until a party was sent out by the Canadian government in 1922 to get all available information. It was then learned that the number of bison in the northern herd is at least 500 with twice as many in the southern herd. The animals are considered by some experts to be superior in size, pelage and stamina to the plains bison to which they are closely related.

THE United States Forest Service is making an intensive study of lightning storms throughout the entire West to secure data valuable in fighting forest fires caused by lightning.

THE French societies of chemical industry have formed a syndicate called "Ammonia" for the production of fertilizer from atmospheric nitrogen to relieve France of her present dependence on Chilean nitrates.

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SCIENCE NEWS

GRAFTED POTATOES

Science Service

GRAFTING, a procedure quite common in tree culture, has been applied to vegetables and flowers by a French botanist who has by this method increased the size and yield, created new species, prolonged the life of plants and intensified the perfume of flowers.

Professor Lucien Daniel, of the University of Rennes, has performed grafting operations on cabbage, lettuce, beans, potatoes, tomatoes and various flowers. Other botanists who have examined his results concede that the fantastic experiments made by Professor Daniel hold much practical promise for the market gardener.

One of the first attempts made by Professor Daniel was to graft the black Belgian bean on a large white Soissons bean. From this combination plant he obtained seeds of an entirely new variety of beans which has remained fixed.

He took a bitter variety of cabbage unfit for food, but which resists frosts and grafted on it a variety that has a good flavor but succumbs easily to cold. The seeds of the hybrid yielded a new variety that tastes good and resists cold.

Some of his most sensational grafts were made on the family Solanaceae to which belong such useful plants as potatoes, tomatoes, tobacco and egg plant. He grafted sections of egg plant on tomato vines. First the grafts produced the regular ovoid egg plant fruit and later on the same branch yielded other fruit resembling that of tomatoes. Finally a true hybrid, round in shape, was obtained.

Professor Daniel has also grafted tomato branches and belladonna on potato vines, and potato stems on egg plants and tomato vines. Potatoes, of course, are simply swollen stems or tubers which develop underground. He was curious as to what would happen when he grafted a potato stem on another plant. Would tubers continue to be produced? Yes, they were, but not underground. Large beautiful tubers hung from the branches like fruit. These aerial tubers when planted yielded a new kind of underground potatoes which were more resistant and developed more quickly than those of which they were the offspring.

A still more fantastic discovery was the finding, among these second-generation hybrids, of three plants which bore both aerial and subterranean tubers at the same time. These tubers being harvested and planted yielded a stable new variety rather late in developing, but delicious in flavor, extra large in size and very hardy.

One of the most recent experiments is the double grafting of belladonna and tomato. Upon a tomato stem, a sprig of belladonna was grafted and then upon the latter again a tomato stem. It was found that the belladonna plant had by this operation lost its property of producing atropin poison which is normally found in all parts of the belladonna plant.

A series of experiments with chrysanthemums and other flowers showed that grafting caused flowers in many instances to yield a more pungent perfume, a fact of great importance to the perfume manufacturers of South France. Numerous trials with other plants are now being made of which the results have not yet been announced.

THE FIXATION OF NITROGEN BY YEAST

Science Service

A YEAST has been discovered that is regarded in informed circles as having immense future possibilities in enlarging the available supply of nitrogenous food. It is a variety of yeast capable of assimilating nitrogen directly from the air when grown in solution of sugar and minerals free from any other source of nitrogenous nutriment.

Dr. E. I. Fulmer, of Iowa State College, developed this yeast, known as Saccharomyces Cerevisiae, Race F, from a cake of commercial yeast. The secret of this success lies not only in the race of yeast used, but also in the development of the proper balance of salts and sugar in the medium by methods developed in his laboratory.

Hitherto the only organisms of any economic importance capable of assimilating nitrogen from the air have been the nitrifying bacteria which grow on the roots of clover and other leguminous plants. The nitrogen absorbed by these organisms is not directly available as food for man or beast, but occurs chiefly in the form of nitrates which nourish the following crop.

The new yeast is what may be called a domesticable organism, suitable for direct consumption by man and animals, which does not especially require for its growth a preexisting supply of nitrogen in the form of nitrates or ammonia.

The potential importance of this discovery lies in the fact that it indicates a possible way of utilizing enormous quantities of saccharine materials which now go to waste, especially in outlying regions of the world. For instance, the cane-sugar industry, which is mainly confined to tropical regions, produces vast amounts of molasses for which no market can be found, notwithstanding that large amounts are employed in the manufacture of alcohol and stock feed. Molasses consists mainly in carbohydrate in the form of sugar; carbohydrates in general are the most abundant of the common constituents of foods, but they can not take the place of proteins —that is, foods containing nitrogen. By using cheap and abundant carbohydrates to support the growth of yeast while it is fixing the nitrogen of the air in the form of protein, the economical production of nitrogenous foods may be greatly expanded.

A NEW TUBERCULAR THEORY

Science Service

A NEW theory, which brings closer the solution of tuberculosis and its cure, was submitted to the con-

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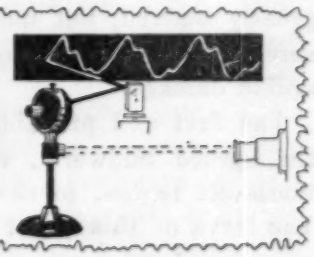

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vention of the American Medical Association by Dr. H. J. Corper, director of the research laboratories of the National Jewish Hospital for Consumptives, Denver, Colorado. This theory holds out the hope of medicinal treatment for tuberculosis, treated mainly with general health measures.

The theory represents three years of research on thousands of animals, since Dr. Corper and two associates discovered that 3 per cent. of carbon dioxide prevents the growth of tubercle bacilli, while 15 per cent. kills them. This discovery explains the prevalence of tuberculosis in the lungs, and the comparative immunity of certain other organs to the disease, since it is a well-known fact that it is in the lungs that carbon dioxide is exchanged for oxygen. The liver, which is supplied with venous blood, and therefore has the highest supply of carbon dioxide in the body, was found to be infected less often than several other organs, which have a higher supply of oxygen.

The indicated cure would be the depositing of carbon in the body by means of the blood, in particles small enough not to block the capillaries, in order to cause a part of the carbon to be deposited in the lungs. Experiments were conducted to determine in what amounts material injected into the veins reached the various organs in the body, and it was found that the lungs received the smallest amount.

Dr. Corper, working with Drs. A. C. Starry and Max B. Lurie, while studying the effect of carbon in tuberculosis in the rabbit, found that carbon administered in liquid suspension intravenously daily for long periods, deposits mainly in the liver and the spleen and to less extent in the lungs, but in sufficient amount to have a retarding influence on the development of pulmonary miliary tuberculosis.

TIMBER DESTROYING INSECTS IN YELLOWSTONE PARK

Science Service

THE great forests of Yellowstone National Park, one of the chief glories of this wonderful region, are seriously endangered by the onslaught of two timber-killing insect pests. So far their ravages have been confined to areas so located that the beauty of the park has not been greatly marred, but unless vigorous and thorough measures are soon taken against them they will do irreparable damage.

The first and probably more serious of these pests is the spruce budworm, which is at work in the Camp Roosevelt region, in the northeastern part of the park. The larva of this insect feeds on the buds and leaves of spruce and fir trees, stripping them naked and leaving them to die. Its area of damage is rapidly eating into one of the most interesting and attractive forests, and dead trees will soon be seen along the roads.

The second pest is the sawfly, which attacks the lodgepole pine. This insect also is a defoliator, killing the leaves by chewing out the soft green parts and leaving a dead shell behind. Its operations are spreading through the forest along the road from the entrance at West Yellowstone, Montana, and will be especially in evidence next season when many of the trees will be dead.

As a means of keeping the epidemics in temporary check, spraying apparatus has been borrowed from the U. S. Forest Service, and poison sprays will be used for a distance of one thousand feet in either direction from the roads through the diseased areas. However, this is recognized by the Park Service authorities as only a relief and not a cure. For permanent results, more thorough measures, going wherever the pests have migrated, will have to be undertaken as soon as sufficient funds shall have been obtained.

ITEMS

Science Service

THE Health Committee of the League of Nations has under consideration the establishment of a center for the observation and dissemination of information concerning epidemics in the Far East. Singapore will probably be selected. Such a center, operating from such a principal southeastern Asiatic port, will be immensely useful to the nations of Asia and to European and American powers having Asiatic possessions and dependencies. It will be able to gain prompt information concerning the outbreak of any epidemic disease, to trace its spread, and to give warning by radio and cable to other ports before the arrival of vessels bearing the infection. The proposal has been sent on to the council of the league for action.

How much should ice cream weigh? The Department of Agriculture proposes a tentative standard weight of 4¾ pounds per gallon, subject to discussion and possible change before it is incorporated in state laws. Department officials suspect that neighborhood ice-cream makers now and then take advantage of the fact that their product is sold by volume rather than by weight. Yet there should be a standard density which the public could demand. A few states have adopted laws dealing with this situation. Kansas has the 4¾ standard on its statute books. Wisconsin requires that the volume of the ice cream when melted shall not be less than one half that in its frozen state, as it is manufactured and sold. A few experiments to determine a proper standard have been conducted in Washington.

PARATOLUOLSULFOCHLORAMIDSODIUM is a bleaching powder recently introduced in Germany. Rather, it is an organic compound which may take the place of bleaching powder. During the war it was used as a disinfectant and experimental surgery is still experimenting with it. But its German makers see its greatest future in the housewife's washtub. They claim it is much less dangerous to linen than the average bleaching powder. Lime salt derived from this compound also is claimed to have valuable properties as a weed killer on gravel paths. Not being easily soluble in water the rain does not wash it away easily.

A BALSAM fir which may prove valuable in producing wood for paper making has been introduced into this country from China.

SCIENCE NEWS

CHEMISTRY AND THE WAR

Science Service

In a war where high explosives and poisonous chemicals were the dominant weapons, Great Britain entered without the facilities or experience for making either, according to a statement made by Sir Robert Robertson, chemist to the British Government, in his presidential address before the chemical section of the British Association for Advancement of Science, in session at Toronto.

No high explosives had been manufactured by the government before the war, no plants existed for turning them out in quantity, no adequate supply of materials was in the country and no satisfactory processes were known. But the chemists of the country were mobilized for research, and the results of their laboratory experiments were speedily put into practice in the erection of plants for the manufacture of the necessary munitions. In certain fields such as metallurgy, the British were strong, but they had allowed themselves to become dependent upon Germany for such organic chemicals as dyes, drugs and photographic developers and sensitizers, especially important in war time.

As Sir Robert said: "While our well-developed position as regards the great inorganic chemical manufactures was a source of strength when the demand came during the war for an enormous production of ammonia nitrate, for example, our neglect to foster a great organic chemical industry led to dangerous delays and improvisations."

The formula worked out for the high explosive amatol which filled the British shell for land and aerial warfare, called for 80 per cent. of ammonia nitrate and 20 per cent. of trinitrotoluene, commonly abbreviated to TNT. But new methods had to be devised for the manufacture of the TNT, and its properties had to be systematically studied in order to obtain a pure and safe explosive. The problem was attacked with such success by the chemists of England that by 1917 amatol was being turned out at the rate of 4,000 tons a week.

The necessary nitrates the British were able, through their command of the sea, to procure from Chile, at least at first, but later, when the shipping was interrupted, they turned their attention to the study of the Haber process of making nitrates and ammonia from the nitrogen of the air, which the Germans had been using before the war. By the end of the war, a nitrogen-fixation plant was in course of erection, and is now employed in producing nitrogen fertilizers for British farmers.

The smokeless powder used as propellant in the British service was made by dissolving gun-cotton in acetone, but since acetone had to be imported a new process was invented using alcohol instead. In order to get the necessary alcohol, beer and spirits were weakened and restricted in sale. This had the additional advantages of saving grain and reducing drunkenness.

The lesson learned from the war-time experience of England is thus stated by Sir Robert Robertson: "The last and more recent stage is in the nature of a recognition that the state is under an obligation to assist science, and in this case the science of chemistry, on which so many important industries are based. It took the war to bring home the danger that, although the record of the country as regards discovery in pure science was unrivaled, its systematic application was too often left to other countries, with the result of lamentable shortages during war and the risk of many industries being ineffective in peace. A measure of government intervention and action appeared requisite, and research became the business of a government department. Outside of the great firms which maintain progressive chemical staffs, the firms in numerous industries have been encouraged and assisted to cooperate in the betterment of their manufactures by the application of the methods of science, and from these associations and the organizations dealing with national problems begins to flow a stream of communications indicative of useful work accomplished. Nor is the foundation of it all neglected, for encouragement is given to workers in the academic field to follow out their ideas, whithersoever they may lead them, in accordance with the truth that 'research in applied science might lead to reforms, but research in pure science leads to revolutions.'"

The Department of Scientific and Industrial Research, established as a war measure by the British Government, has become a permanent national policy and continues actively engaged, not only in investigations relating to preparedness for war, but also in those dealing with public health, food supply, fertilizers and metallurgy. There are now 375 chemists in state employ, and the government appropriates about $250,000 annually as grants to 156 chemists engaged in research.

THE SEGREGATION OF RACES

Science Service

Holding that "when different races live side by side, the more primitive race, unless conditions be imposed upon it fatal to its spirit, will outlive the other wherever the struggle for existence is keen," Professor J. W. Gregory, of the University of Glasgow, in addressing the Geographical Section of the British Association for the Advancement of Science at Toronto, advocated exclusive territory as the best way of treating racial difficulties, in places where the policy can be applied.

He does not think that policy would be consciously adopted in the United States because of political reasons, but thought that it would ultimately come about by the natural drift of circumstances. The Negro problem in America has, in his opinion, been steadily growing from bad to worse during the last twenty years, and none of the conceivable constructive measures for its solution seems likely to be put into effect.

"Absorption is rejected as it would make the United States a nation of octoroons," he said, "but the infiltration of Italians and Mexicans and other South European peoples, who have no repugnance toward inter-marriage, may lead to the occupation of the cotton districts by a hybrid race similar to that of tropical South America.

"This process," he said, "would render impossible the continued refusal of political and municipal rights to any citizen who has a trace of Negro blood. The colored people would regain the suffrage, and the political development of the southern states on normal American lines would be impossible. If the Whites in the southern states be divided between Republicans and Democrats, the Negro vote would hold the balance of power; and owing to the considerable over-representation of the southern states in proportion to population, American politics might be determined by the Negro vote. Such a situation would be intolerable to the northern and western states. Hence, to avoid it, they might agree to the south-eastern states being formed into a group with a special measure of home rule in some departments of federal jurisdiction. This solution may take a century or more to develop; but the geographical considerations indicate it as the most probable issue from the Negro strength in the south-eastern states."

In South Africa where the blacks outnumber the whites more than three to one and are increasing the faster, Professor Gregory thinks "the maintenance of the white supremacy and even of a white Afrikander people is doubtful." The day's wages for a white laborer are about the same as the month's wages of a colored laborer doing the same sort of work. The rule of the white minority is threatened by the rise of an active Negro party, "largely inspired from the United States" and increasing in numbers and influence. The speaker argued that "as white labor is excluded from some parts of South Africa in the interest of the Negro, it would seem only fair that the Whites should have a corresponding advantage elsewhere and especially in districts which were practically unoccupied until the European entered them. Most of Africa is the home of the Negroes, whose numbers are increasing faster than any other population in the world."

But there is one continent that may be kept exclusively for the whites and completely occupied by them. This is Australia, for Professor Gregory believes that even the tropical northern territory can be colonized by white men now that tropical diseases are being conquered and that Europeans are learning to live in hot and humid climates.

MECHANISM AND PURPOSE

Science Service

DENYING that the human being can be explained as a superior penny-in-the-slot machine, Professor William McDougall, of Harvard University, in an address at Toronto, on August 8, urged psychologists of the British Association for the Advancement of Science to recognize the striving aspect of human nature as a fundamental category of psychology.

He pointed out that the mechanistic confidence of the nineteenth century is fading away, as the complexity of the living organism is more fully realized, as its powers of compensation, self-regulation, reproduction and repair are more fully explored.

"Let the budding psychologist ponder some phase of human life that is dominated by some strong but thwarted desire," he said. "Let him consider the strange yet familiar case of Romeo seeking the Juliet who is forbidden to him. How this desire to see, to hear, to touch the loved one dominates his life, waking and sleeping! How it fevers his blood; wears him to a shadow; keeps him running to and fro, scheming, trying, hoping, desponding, exulting, despairing, and always desiring! The desire governs all his thinking and acting; the most rooted habits of mental associations are as nothing in the course of this torrent of purposive activity, all directed to Nature's most imperative goal.

"Can we accept any account, any description or explanation of human life, which leaves out of the picture this all-important aspect that we call impulse, desire, striving toward a goal?"

It may be, Professor McDougall suggests, that eventually men of science will agree that there are in the universe two ultimately different kinds of processes—the mechanistic and the purposive—the strictly determined and the creative, the physical and the mental. Or it may be that, eventually, one of these may be shown to be merely an appearance of the other, an appearance due to the present limitations of our understanding.

He predicted, however, that if the two types of process are ever resolved into one, the purposive type that we regard as the expression of the Mind will be found to be more real than the other.

THE GAME ANIMALS OF CANADA

Science Service

DEPLETION of the larger game animals, even in the deepest Canadian wilds, is a disaster that hangs over the heads of the present generation, in the opinion of Dr. Rudolph Martin, chief of the division of biology of the Victoria Memorial Museum at Ottawa, in a paper read before the British Association at Toronto.

Not only have hunters and trappers nearly exterminated many fur-bearing species for the supply of the markets of fashion, but the breaking up of the prairies under the plow has deprived many hoofed and horned species, like the prong-horn antelope, the bison and members of the deer family, of their pastures and is killing off the species by preventing natural increase. A last refuge of many animals, and one which Dr. Anderson believes should be theirs in perpetuity, is the Arctic.

"A large area of arctic and sub-arctic lands beyond the range of possible cultivation are still occupied by large numbers of wild caribou and a few remnants of musk-oxen," he said. "The Arctic can never be agricultural, but there is a probability of developing a domestic reindeer industry in certain districts and attractive possibilities in attempted domestication of the musk-ox. The economic advisability of replacing a valuable, healthy and thoroughly adjusted wild stock by

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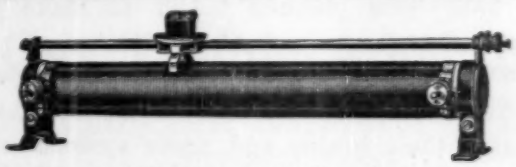

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more expensively reared domestic stock in remote districts is questioned.

"The proportion of the Canadian Arctic area which is actually suited for pasturage is largely problematical and needs investigation rather than speculation. Tundra is not prairie, but consists mostly of mossy swamps or comparatively barren upland. Many extensive areas are rocky or sterile and severe climatic conditions reduce materially the amount of vegetative growth on the limited fertile areas, so that a much greater acreage is required for the support of each animal than in more friendly regions. Population must necessarily be sparse outside of mining areas and enormous distances from markets will prevent profitable commercial exploitation under present methods of transportation."

Dr. Anderson's remarks concerning the Canadian Arctic regions apply with equal force to American possessions in interior Alaska, and to vast tracts in northern Siberia, which can never be cultivated, but must remain as permanent grazing lands.

THE USES OF ARMOR AND ACTIVITY IN EVOLUTION

Science Service

CONTINUED aggressiveness is the price of existence, as the rocks reveal the story of the tides of life through the aeons, according to Professor W. W. Watts, who spoke before the section of geology of the British Association.

Whenever any form of life has fallen back upon passive resistance it has perished, he said, through the very expense of keeping up the protective armor. There has been a tendency in life forms, he pointed out, once having attained to great size to abandon functions promoting swiftness in attack. The armored fishes and reptiles he mentioned as cases in point. The latter finally survived by throwing away their protection for the most part and developing swiftness and fighting qualities.

"Every time," said Professor Watts, "the race has been to the swift, active and strong, and those that trusted in defense rather than defiance have gone under in competition with those prepared to face the risks involved in attack. The fact that turtles and armadillos have survived to the present endorses rather than vitiates the principle. The human brain is the product of all the world's yesterdays, and the entire course of evolution could not have been planned better to make possible the existence of such an overlord of creation.

The giant reptiles of the mesozoic period, whose skeletons now fill the museums of the world, may have perished, because their brains and nerve systems were not sufficiently developed to cope with the conditions they faced. The actual physical changes of the period do not account for their disappearance.

THE GENEALOGY OF MAN

Science Service

A NEW way of tracing back the genealogy of man to pre-human forms was pointed out at a meeting of the Section of Anthropology of the British Association by Dr. Charles Hill-Trout. He argued that in comparing the skulls of man with the anthropoid apes the skulls of the young should be used instead of those of adult individuals, since the immature skulls would be likely to represent the ancestral type more closely.

By carrying out such a comparison of the skulls of modern children and of the young of the primitive Neanderthal man with the skulls of young apes, a closer conception of their common ancestor is obtained and it is then seen that, contrary to what has been most generally held, it is the anthropoid ape and not man which has departed most from the ancestral type. Man himself has retained most nearly the skull characteristics common to both branches of the primates. This ancestral form is best typified by the skull found in the Thames gravels at Piltdown, Sussex, and named the Eoanthropus. He is supposed to have lived about 150,000 years ago and his skull is much more like the modern man than the skulls found in the Neanderthal ravine near Dusseldorf, in 1858, which are thought to be about twice as old.

ITEMS

Science Service

A REAL problem in the production of large amounts of high voltage direct current power may have been solved in England by a so-called transverter, now on exhibition for the first time at the Empire Exhibition at Wembley, according to Professor G. W. O. Howe, president of the engineering section of the British Association. The apparatus consists of an arrangement of transformers and a system of rotating brushes, whereby a three-phase alternating current supply is converted into an almost steady continuous current. The apparatus at Wembley is designed to deliver a continuous current at 100,000 volts. It can also be used for the reverse process. It would thus enable a three-phase generating station and a three-phase substation to be connected to a direct current transmission line, thus avoiding not only the maximum voltage of 1.4 times the effective voltage, but also all trouble due to the capacity and inductance of the line. The disadvantages of the apparatus, however, remain to be seen.

NEARLY 200 species of fossil plants and animals unearthed near Toronto show that between the great ice ages Toronto had a climate like Pennsylvania, Dr. A. P. Coleman, of the University of Toronto, told members of the British Association. The geological formation from which these fossils were obtained is the most extensive and important interglacial formation in America.

MENTAL fatigue is more important than physical in industry, said Dr. C. S. Myers, director of the National Institute of Industrial Psychology of Great Britain, speaking before the section of psychology of the British Association. In industry, he said, there are three sources of fatigue: Exhaustion of the store of material energy; accumulation of waste products in the body, and the continuous "set" of controlling or directing which comes from maintaining the posture of the body or the orderliness of its acts.

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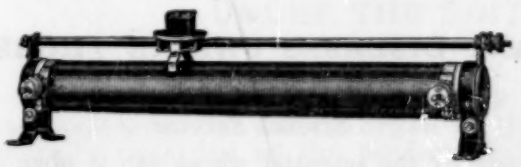

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SCIENCE NEWS

MAKING PLANTS TURN MORE SUNSHINE TO FOOD

Science Service

POSSIBILITIES of increasing the food supply of the world through study of agricultural factors as yet little understood are enormous, according to Sir John Russell, F.R.S., president of the agriculture section of the British Association for the Advancement of Science.

No attempt has been made in the field to control two of the most important of these factors influencing the growth of plants, light and temperature, although both now are subjects of experiment. He spoke of four possible fields of experimentation which hold out promises of increasing yield and quality many fold:

(1) Increase of plants in efficiency as transformers of the sun's energy. At present plants transform only about one per cent. of this energy. The most efficient plant lags far behind the worst motor car. If some means of utilizing two per cent., the amount of energy transformed by a steam engine 100 years ago, would be obtained it would make the average wheat crop in England 400 bushels per acre instead of the 200 obtained now. Sir John said that increases in plant growth amounting to from 20 to 25 per cent. have been obtained in England by the influence of high tension electrical discharge which presumably acts by increasing in some way the efficiency of the plant as an energy transformer. The value of experiments along this line, he said, lies in the great increase in yield obtainable by a small increase in efficiency.

(2) Adaptation of plants to both soil and climate. A soil moderately fertile under one set of climatic conditions may be absolutely unproductive in another. A clayish soil which in England is almost barren proves excellent grain and cotton land in the Sudan. Clay under wet conditions becomes a serious drawback. It might be possible, Sir John said, to find some mathematical relationship between rainfall and the degree of objectionableness in clay. The fertility of soil in any given locality is dependent to a considerable extent on the fact that it fits in with the climatic conditions in supplying the needs of the plant. To make the complexity worse the soil itself is not constant but is always varying within certain limits.

(3) Temporary changes in plants brought about by changed conditions, wholly independent of the plant breeder. It is a commonplace among farmers that certain soil conditions influence not only the yield but the quality of crops. At Rothamsted, England, the sugar content of mangold roots, an important factor in determining feeding value, was increased by increasing the supply of potassium to the crop. Grass has been increased in feeding value, quite apart from any increase in quantity, when treated with phosphates. At Rothamsted a high-class cook can distinguish between the quality of potatoes fertilized with potassium sulphate and those fertilized with potassium chloride. Grain, however, has proved more difficult to alter by changes in environmental conditions although the protein in wheat has been increased by increased soil moisture.

The Institute of Brewing in England now is making a full investigation of barley, still the basis for the national beverage. It has been found that increased moisture increases the amount of nitrogen in the grain and so also does an increased nitrogen supply, although to a much less extent. Other substances, such as both potassic and phosphatic fertilizers, may decrease the percentage of nitrogen, although they do not always do so. The laws regulating these changes still are unknown, Sir John said.

(4) Control of pests or parasitic diseases, which in England ruin at least 10 per cent. of the total value of the crops each year. These may be controlled, Sir John said, through study of the three controlling factors. Pests and parasites do harm only when they are present in an attacking state, when the plant is in a sufficiently receptive state, and when conditions are favorable to the development of the pest. Complete control of any of these three conditions would end all plant diseases, he said. If plants could be pushed through the receptive stages before the pest was ready they would escape attack. In the Sudan cotton thrips have been placed in a measure under control by giving the plants protection against the drying north wind and so maintaining a more humid atmosphere—a condition under which the plant thrives better than the pest and is past the stage of attack before the latter is ready. The best remedy, he said, still lies with the plant breeder by producing a variety immune to all diseases.

PLANT DISEASES UNLIKE THOSE OF ANIMALS

Science Service

THE path of the scientist whose job it is to safeguard the health of our crops, orchards and gardens is not a path of roses, according to Professor V. H. Blackburn, president of the botanical section of the British Association for the Advancement of Science. In his presidential address, Dr. Blackburn brought out a number of important aspects wherein the diseases of plants differ from those of animals and man, and are more difficult to handle.

The most important difference of all, perhaps, is the relatively small amount of help that the plant doctor gets from his patients. Animals and man frequently give themselves a lifelong cure of a disease by having it once; such permanent resistance is built up by an attack of smallpox—or its artificial shadow, vaccination—and is termed "acquired immunity." So far as is known, plants never acquire immunity and succumb to a second or third or twentieth attack of a disease as easily as they do to its first onset.

It is true that a plant may be naturally immune from the beginning, just as some fortunate individuals in human society are immune to some diseases from birth. But even in such naturally immune plants, as well as in

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those more readily afflicted, resistance to attempted invasion on the part of the disease-producing parasite is limited to a small part of the plant tissues. The struggle takes place within the confines of a few cells. This is due largely to the absence of anything like a blood circulatory system in plants. Plant sap flows only one way or at least does not flow in a closed circuit, as does blood in animals. The more perfect circulatory system of animals permits all parts of the body to manufacture resistant substances, like antitoxins, which are then delivered to the fighting front by the transportation lines of the blood system. It is the difference between mobilization with roads and without.

These two circumstances, inability of plants to acquire immunity by one attack of a disease and their lack of a circulatory system, render unlikely the development of anything like vaccination or serum therapy for plant diseases, and force us to fall back on the selection and breeding of plant strains with natural immunity, supplemented with spraying and other treatments to kill the disease-producing organisms as they alight on the leaves and stems of the plants.

There are three principal modes of attack employed by the parasites that cause plant diseases. They may get in through accidental wounds, as corn smut does to a large extent; they may go in through the breathing-pores or stomata, like wheat rust; or they may actually bore or push their way in through the unwounded plant skin. The first two methods are employed by both bacteria and fungi; the third is used only by fungi.

It has long been a riddle how a fungus, which is in the beginning a mere slender white thread, can push its way through the relatively tough skin. Early theories, which held that the fungus was attracted by some chemical substance exuded by the plant and in turn used chemical means to dissolve a hole through which it might pass, are now in abeyance. It seems more likely, in the light of recent investigations, that the affair is simply mechanical from beginning to end. The fungus thread seems to glue itself to the fated spot by means of a kind of gelatinous substance, while the central part of the thread pushes a hole through exactly like a shoemaker's awl.

Once inside, the fungus may be virulent enough to kill the tissues and make a meal of them or it may simply "live along" with them, sucking out part of their nutriment, or the tissues may turn at bay and fight. Their resistance may be physical and consist of laying down a layer of cork or other tough, impenetrable substance against the invader; or it may be chemical, meeting the poison attack of the fungus with a poison counter-attack. Sometimes this struggle is so bitter that both fungus and invaded tissue kill each other.

ORIGINAL CRUST OF EARTH SHOWS EARLY CLIMATE WAS COLD

Science Service

THE earth's earliest rocks, formerly supposed to have been formed by the cooling of the original hot, melted crust of the globe, were made in a cool climate, Professor A. P. Coleman, of Toronto University, informed the British Association for the Advancement of Science.

Although these early rocks contain no fossils their formation indicates cooler conditions than those under which the great fern forests which formed our coal measures flourished and cooler than the time when dinosaurs roamed the earth.

The evidence is growing, according to Professor Coleman, that climates and geological processes in that early time were not widely different from those of later times.

Passing downwards from the base of the Cambrian in Canada, the Keweenawan includes red sandstone suggesting desert conditions; the Animikie, with gray carbonaceous slates, was probably a time of cool moist climate; the Huronian, including the Cobalt tillite, was a time of glaciation.

Below this, after a profound break, is the Sudbury or Timiskaming series, mostly of waterformed materials, including 4,000 feet of well-banded graywacke and slate, evidently of seasonal origin. This gritty material and some boulder conglomerates make one suspect a cold and perhaps glacial climate.

After another profound unconformity the Keewatin and Grenville series with carbonaceous slate and thick beds of limestone suggest conditions not very different from the present. The thousands of feet of boulder conglomerate in the Dore series are thought by some to be torrential deposits, but might equally well be accounted for as glacial.

"On the whole," Professor Coleman concluded, "the pre-Cambrian formations indicate cooler conditions in the Paleozoic up to the end of the Carboniferous and much cooler conditions than those found in the Mesozoic."

WATER ABSORPTION IN PLANTS

Science Service

How much water plants absorb and when and why are subjects of inquiry on the part of scientists working in the laboratory of plant physiology of the Johns Hopkins University. The name of the instrument used for measuring the potations of plants is appropriately enough the "potometer." An improved form of this device, invented by Dr. B. E. Livingston and Mr. J. D. Wilson, promises to yield results of great interest to botanists and eventually of use to foresters, irrigationists and others interested in plant industry.

Heretofore all models of the potometer have been made for attachment to the cut ends of plant stems or branches. This has yielded data of some interest and value, but after all a cut branch is a wounded plant and one can not expect results to be quite normal. The device of Dr. Livingston and Mr. Wilson enables whole and uninjured plants, with full sets of roots, to be used, thus giving results more nearly approaching conditions in nature.

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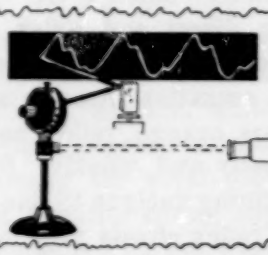

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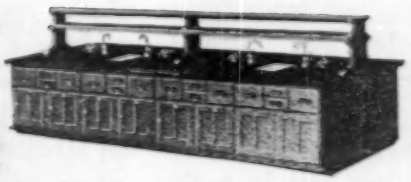

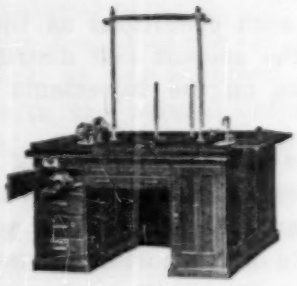

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tubing. The rubber stopper is pierced with two holes.

Through one of the holes a cutting of a woody stem, like willow or oleander, is passed, so that the rubber fits tightly about the bark. The cutting is allowed to stand in the jar of water until it strikes root and sets up in business as an independent plant. Then the jar is filled up level with water and the stopper set closely in so that all air bubbles are squeezed out. The piece of slender glass tubing is passed through the second hole in the stopper and filled with water. As water is taken up by the plant, the tube acts as a gauge, indicating how much goes in and how fast it goes.

With a lot of these potometer jars, the two scientists are investigating plants of several different species, determining the effects of sunlight and shade, varying temperatures, factory smoke, poisonous gases and a number of other factors upon the rate of water intake.

FOOD OF SEA FISH INFLUENCED BY TEMPERATURE, LIGHT AND SALT

Science Service

THE migrations of fishes, long a matter of much commercial and scientific importance, received light from a new angle in discussions before the meeting of the British Association for the Advancement of Science by Professor A. G. Huntsman, of the University of Toronto. Professor Huntsman studied, not the fishes themselves, but the host of minute plants and animals, called the plankton, that constitute their chief food. Influences that control the movements of the plankton must also control to a large extent the movements of the fish that feed on them.

Professor Huntsman has found that the organisms in the plankton respond in the main to three sets of influences: light, temperature and degree of saltiness or salinity. Light does not penetrate into water to any great depth; below a few hundred feet the world of the waters is perpetually dark. Some of the animals in the plankton like the dark and dive toward the bottom during the day, while others like the light and luxuriate on the surface during the sunny hours. They are similarly affected by differences in temperature, being distributed both in depth and latitude according to the prevailing temperature of the water. Finally, salinity affects them. The ocean is not equally salty everywhere, but has more salt in quiet waters that receive few rivers, especially in tropic latitudes, where evaporation rates are high, like the Mediterranean and Red seas, and less salt in regions where much fresh water or ice comes in and there is little evaporation, as in the Arctic Ocean. It is the influence of such conditions as these that makes for differences in the amount and distribution of the plankton and hence on the movements of fishes.

Ocean currents complicate the situation by mixing up waters of different temperatures and salinities. Warm waters, like the Gulf Stream and Japan Current, profoundly affect the cold-water life of the northern oceans, while cold waters of low salinity, like the Labrador Current, reverse conditions in the warmer southern areas.

ITEMS

Science Service

DR. PAUL E. SABINE, director of the Wallace Clement Sabine Laboratory of Geneva, Ill., speaking before the section of physics of the British Association, stated that transmission of sound through masonry walls does not depend on the material or its structural stiffness, but varies in proportion to the weight of the wall per unit of its area. Dr. Sabine's researches have the double object of minimizing echoes and reverberations in auditoriums and of assisting the construction of sound proof rooms. From his work on the transmission through partition walls of non-musical impact sounds, such as the clicking of a typewriter, he has developed equations which predict what fraction of sound energy will be absorbed by flexible structural units of wood, glass and steel, on the one hand, and "deadening quilts" of porous material on the other.

FELLOW feeling between the eyes was brought into play in experiments conducted to discover the fundamental processes of color vision, Professor Frank Allen, of the University of Manitoba, told the section of physics of the British Association. The left eye first was fatigued with a series of monochromatic spectral colors and the effects produced on the right eye measured through the critical frequency of the flicker. The results showed the existence of visual sensory reflexes, the chief effect of which is to enhance the sensitiveness of the receptors of all three fundamental color sensations in the right eye. In a similar manner the right eye then was fatigued and both direct and reflex effects simultaneously were produced. The simple colors, red, green and violet, affect one sensation directly and two reflexly. The compound colors, orange, yellow and blue, affect two sensations both directly and reflexly. Similar experiments were tried by confining fatigue to one side of the retina and measuring the reflex effects produced on the other side. They were precisely the same as in binocular experiments.

HOW the bodies of man and other warm-blooded animals are kept at an even temperature, and always at the same temperature, was the subject of a paper before the British Association by Drs. W. B. Cannon and A. Querido, of Harvard University. Evidence has been obtained that the secretion of the adrenal glands, small bodies situated near the kidneys, is increased when there is liability of lowered temperature through the loss of heat from the body. When animals deprived of the use of the adrenal glands are threatened with chilling, they shiver, whereas normal animals exposed to the same temperatures do not. This is held to indicate that the former "feel the cold," for shivering is known to be a sort of emergency method of getting warm. It has been known for some time that adrenalin extract has the effect, when injected into the blood stream, of speeding up the oxidative or fuel-burning processes in the body.

ELECTRIC lamps, many of them automatically operated, are replacing oil and acetylene lamps used in the 5,800 shore beacons and buoys that warn ships of dangers along the coasts of the United States.

SCIENCE NEWS

SOME PAPERS PRESENTED AT TORONTO

(Science Service, Dr. Edwin E. Slosson, Director)

FROM the structure of a worm to the constitution of an empire was the scope of the presidential address of Professor F. W. Gamble, of the University of Birmingham, delivered before the Zoological Section of the British Association for the Advancement of Science. His guiding theme was the new theory of bodily control, worked out by Professor C. M. Child, of Chicago, which has captured the imagination of the younger generation of zoologists and opened to them a promising field of experimentation. Child worked mostly with planarians, the flat, soft, slimy, worm-like creatures that you find when you turn over a stone in the stream. They are the simplest of creeping things, but a head and a tail can be distinguished and Child found that the head end was the point where the chemical processes of life were most active and that the activity tapered off toward the tail. But when the planarian gets too long for the head to keep the whole length in due subordination, a new center of activity starts up in the hindward half which finally breaks away from the parent body. Then the tail end grows a head and the head end grows a tail, and so the one becomes twain. Now it seems that Child's "hypothesis of metabolic gradients," to give its proper name, is applicable to higher organisms and groups of organisms, perhaps even to human society. In the development of an egg into an embryo the particular point in the protoplasm that is most energetic gets ahead of the rest and eventually becomes the head of the creature, while the more sluggish masses fall into their proper stations and become the various organs. Among the coral colonies, the head or apex, so long as it remains strong enough, keeps the other branches from budding off, but when the shoot grows too long for such centralized government, a remote bud may start up and secede to form an independent colony. But although the apex in all cases is the most vital center, yet it is also the most susceptible to poisons and easily killed. In that case a new head may arise from the reserve and comparative inactive basal substance, as in the case of worms, but in the case of highly organized and differentiated bodies or societies this is impossible, and so the whole perishes. As Professor Gamble puts it: "Life under dominance tends to exhaustion whereas isolation leads to a renewal of activity at a lower level of complexity," and he calls attention to instances in the history of the world where a primitive people, long isolated by remoteness or caught in some back-water, has come forward to give new life to a decadent civilization. These are but a few of the many thought-provoking points in this fertile and far-reaching paper, which proves, as Professor Gamble suggests, that experimental zoology may give lessons to practical politics.

GERMANY has lost her chance, what little chance she had, of recovering her African colonies by trading off for them the formula for curing the sleeping sickness. For France has now the same remedy, or, as the druggists say, "something just as good." Bayer 205 has a rival in Pasteur 309. Such was the announcement of H. H. Dale, head of the department of pharmacology of the National Research Council, London, in his presidential address before the Section of Physiology of the British Association for the Advancement of Science. Here is a case where a coal-tar compound plays an important part in international politics. For when Africa had been partitioned by the European Powers, they found much of their territory becoming uninhabitable by the spread of the sleeping sickness, which devastated a belt two thousand miles long and in places one or two hundred miles wide, stretching up the Congo from the Atlantic almost to the opposite ocean. The disease was discovered to be caused by a little creature with a long name, Trypanosome, an infinitesimal wriggler, which is carried by the tsetse fly and infects the blood of man and beast. German chemists set about to find a drug that would kill the creature without harming its host and after fifteen years of effort succeeded. But meantime Germany had lost her African possessions to her conquerors, France, Britain and Belgium, and so had no sleepers to cure. The formula for Bayer 205, or as it is now called "Germanin," was kept secret, but it was intimated that it would be disclosed if the Allies would return the German colonies. This involved an extensive real estate transfer, for the German African possessions amounted to a million square miles, or a third the size of continental United States or habitable Canada. So the Allies showed no eagerness to buy the recipe at this price, but set their own chemists at work on the problem, following such clues as could be obtained from the pre-war Bayer patents. And now Fourneau, working in the Pasteur Institute, Paris, has found that his three hundred and ninth preparation has "similar and probably as valuable properties" as Bayer's two hundred and fifth. Injected into the blood it will not only free the animal from the trypanosomes in a few days, but render it immune to further infection for months afterward. At any rate, this previously incurable and fatal disease seems to have finally been conquered, and vast areas in the tropics may now be opened to settlement. Dr. Dale also told of the war against other animal parasites by the invention of salvarsan and similar arsenical and bismuth compounds. The oldest of all such specific remedies is quinine, which destroys the malarial parasite. Dr. Dale holds that in all such cases the drug does not act directly by killing off the parasite but, as was supposed by Ehrlich, works in cooperation with the natural defences of the body by making the blood uninhabitable to the invader.

THE bankruptcy of the scientific materialism of the nineteenth century was the theme of Professor William McDougall's presidential address to the Section of Psychology of the British Association for the Advancement of Science. In the days of Spencer, Huxley, Tyndall and

Weismann it was held that life and mind, as well as the inanimate world, could be completely accounted for on the physical principles that determine the action of a machine. Every atom of the brain was then supposed to pursue its predetermined course impelled by physical forces. But if the mind could not exert any influence on the operations of the brain without violating the law of the conservation of energy, consciousness, which seems all-important to us, must be an idle and superfluous accompaniment to chemical processes. But the modern view of the physical universe, as set forth by Einstein, Eddington and Soddy, is very different from and less embarrassing than the old mechanical conception, for, as the speaker said, "The atoms are gone, matter has resolved itself into energy, and what energy is no man can tell, beyond saying that 'it is the possibility of change, of further evolution.'" The modern psychologist, according to Professor McDougall, should postpone consideration of the old physical and metaphysical puzzle and start out from two indisputable and practical facts: first, that sometimes men do create new things in art, science and literature, and, second, that when a man strongly desires an end and perceives certain bodily movements to be a means to that end, these movements follow upon that desire and that perception. "The most fundamental need of psychology," said Professor McDougall, "is the adoption without reserve of the conception of purposive striving as valid, useful, nay, indispensable, and therefore true. We should now easily find the courage to be anthropomorphic in describing man." In short, he holds that it is time that psychologists should cease imitating the methods of the other sciences and should boldly claim "self-determination," or "at any rate dominion status for their science." William McDougall came to Harvard in 1920 after training and experience in the universities of Manchester, Cambridge, Oxford and Göttingen, and he has made the chair of psychology a factor in American thought as it was in the days of his predecessor, William James. He criticizes with equal energy all three of the leading schools of psychology, the behaviorists, the introspectionists, and those who attempt a compromise by adopting both these opposing points of view and putting them in parallel columns. But to Professor McDougall "the life of man is one long series of purposive strivings. And even in his dreams, as we now realize, thanks to Professor Freud, the striving goes on, bringing what strange and partial satisfaction it may to the buried, thwarted and denied tendencies of his nature."

Is race suicide due to natural or artificial causes? Is a declining birthrate a menace or advantage to a nation? These were questions discussed by economists of the British Association for the Advancement of Science. The director of the London School of Economics, Sir William Beveridge, pointed out that the fall in the birthrate was no gradual trend toward less fertility, such as has been ascribed to later marriages, the cityward movement of population and other causes, but a definite biological revolution which can be located as beginning about 1881. Up to that time there had been no serious decline in the birthrate of western Europe or any other part of the world for which the census exists; from that time forth it became almost universal. "The sudden development of birth control at that particular date was not," the speaker inferred, "due to any increase in the need for control, but to improvements in the means of control, to invention and exploitation of new powers over nature, like those given by chloroform or gunpowder, but unlike them in being driven underground by public opinion and the law. The fact that birth control developed, not when or because it was particularly needed, but when and because the means of control happened to be improved, *i.e.*, as the result of an underground invention, makes it all the more important to study scientifically and discuss frankly all the possible effects of control under varying conditions, on health, on numbers, on the quality of population and on social institutions." The birthrate remained high in Roman Catholic countries such as Ireland and Italy where artificial means of limiting births are opposed on religious grounds. The only Protestant nations keeping up the big family custom after 1881 were in thinly populated Scandinavia. In Holland the Catholic provinces of Limburg and North Brabant and the very sparsely peopled province of Drenthe are the only ones in which the birthrate fell by less than twenty per cent. in the last fifty years. This sudden and dramatic change from big families to small makes the period of the 1880's, according to Sir William Beveridge, one of the crucially significant turning points of human history. That the decline in the birthrate has been accompanied by lessened mortality is a great gain in human happiness but the speaker pointed out that even this has its dubious side, since a community of stationary population with no great surging influx of new births becomes too readily a nation of conservative old men and women. An analysis of the British census by Professor R. M. MacIver, of the University of Toronto, confirms the common opinion that the most successful classes with respect to wealth and social recognition are the least successful in reproducing themselves. Dividing the British population into classes, with capitalists, employers and highly educated professions at the top and the unskilled laborer at the bottom, each step downward of the social scale shows an increase in birthrate although this is usually offset to some degree by a higher deathrate. Professor James A. Field raised the timely question as to whether eugenists were not on the wrong track in assuming that a relatively low birthrate among the prosperous classes was necessarily a sign of racial decadence. The economic virtues which lead to wealth are not at all the same as the biological merits in which the eugenist is interested. Our present competitive economic system makes children a handicap and often gives special advantage to qualities which from the biological point of view are valueless or worse. The eugenist is less concerned to multiply captains of industry or specialized geniuses than to encourage a normal type of sanity, soundness and all-round capacity.

THE new theory of mountain-building known as "isostasy" had the floor at Toronto. We used to think

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that the earth's crust floated upon a sea of molten rock and that the contraction of the earth in cooling occasionally thrust up wrinkles of mountain ranges. But now-a-days the earth is regarded as solid all the way down, but increasingly plastic under pressure at lower depths. So as a mountain wears away from erosion, as all mountains do, it gradually rises since the pressure is removed, while the sea where the eroded rock is deposited subsides, until the two areas are balanced. That is, there is an undertow of viscous rock many miles underneath that adjusts the equilibrium whenever it is disturbed by superficial shifts. One of the causes of the rise and fall of land is the mountainous ice-sheets that have piled up and melted off in the successive glacial periods. Professor A. P. Coleman, of the University of Toronto, stated that ice was once piled up on Labrador thousands of feet high, while the ice-sheet over the central states was only a few hundred feet thick. As the ice melted along the margins of river, lake and sea, these beaches were pushed up from underneath by isostasy. Such raised beaches can be seen in Ontario and Quebec, Newfoundland, Labrador and the Maritime Provinces, often elevated hundreds of feet. The slow process of readjustment from the last glacial period is still going underneath parts of Canada. The eastern end of Lake Ontario is rising more rapidly than the western, and this floods the mouths of the Don and Humber rivers of the Toronto district. Professor Reginald A. Daly, of Harvard, also discussed the effect of the great load of ice formerly covering Labrador and Keewatin. The depression of this weighted area caused the rise of ring of land around it beyond the edge of the glaciated region. The same thing happens on a large scale and Dr. Daly held that "there is sufficient evidence to support the theory that an equally complete and perfect response to the gravitational forces took place when the continent was weighted down with huge masses of ice."

MORE than 400 years ago a man died in British Columbia and nature herself erected over his grave a tombstone on which she inscribed data concerning him. The tombstone was a tree. Anthropologists, digging under its roots, found a skull of unusually narrow type in which a hole had been bored, presumably so that it could be filled with some preservative material. How long ago did the red man practice this form of embalming his dead? For a time this question puzzled the scientists. Then they turned to the tree. Annual rings of growth indicating more than 400 years were found on the trunk. A still greater age for the skull is probable since the outside layers of this stump had been burned off. The studies leading to this interesting conclusion were conducted under the direction of Harlan I. Smith, of the Geological Survey of Canada, who addressed the Section on Anthropology of the British Association.

MICROSCOPIC analysis of cross-sections of fragments of a fossil fern have revealed the living anatomy of giant plants which flourished aeons ago, Professor W. T. Gordon, of King's College, London, announced to the British Association. Petrified stems the size of trees, twigs clothed with bark and buds with their leaves attached recently found in Haddingtonshire, England, show that this fern was much simpler than formerly supposed by botanists.

MUSHROOMS and their fungous kindred that grow in cellars have always been thought of as different from other plants, in that they need no light. But Dr. W. Robinson, of the University of Manchester, speaking before the British Association, has announced a paradox arising out of his experiments with fungi; for while these plants can and do grow in the dark, they still must have light at certain periods of their lives. Their reproductive processes require light. The species on which Dr. Robinson worked brought forth reproductive structures in the dark, but they were sterile, and spores capable of growth did not appear until the plants were subjected to light of a certain minimum intensity.

"WHERE light is intense, it is unusual to find acid soils," Professor J. L. Sager, of the University College of the Southwest of England, reported to the British Association. By analyses of soils from forests composed of trees affording varying amounts of shade, Professor Sager showed that the alkalinity or acidity of the soil is related to light intensity. Where there is much shade, as in thick spruce forests, soils are acid. Where the shade is less, as in larch forests, the topsoils are more alkaline.

GEOGRAPHY as taught in schools should deal with the world as a coherent whole, not as a number of independent fragments, Ernest Young, of the Committee on Education of Middlesex, England, reported to the British Association. Thus, he said, foundations of a sane internationalism can be laid. He urged the importance of giving each region a human interpretation.

VARYING the amount of cobalt added to steel changes its magnetic properties, E. A. Watson, Canadian metallurgist, told the engineering section of the British Association. Use of cobalt in permanent magnets, however, means increased expense. Only in rare instances would the new methods prove profitable.

CANADA has total water power potentialities of more than 18,000,000 horse power, of which 3,227,414 horse power is now developed and 750,000 under construction, J. B. Challies, director of water power of the Dominion Department of the Interior, told the engineering section of the British Association. The greatest part of the undeveloped water power, he said, is directly or indirectly the property of the crown.

THE deep gorge known as Red Deer Valley in Alberta has yielded more dinosaur skeletons than any other region in the world, according to Professor W. A. Parks, of the University of Toronto. At least 130 specimens have been hewn from the hills, the fifteen major specimens including remains of some of the largest animals that ever lived on land and some strange dragons new to science.

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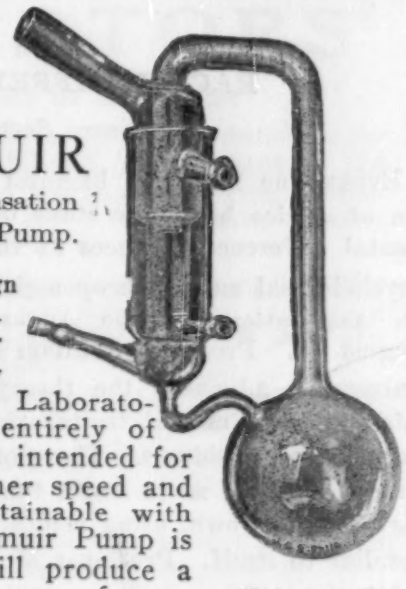

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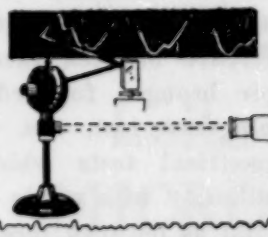

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SCIENCE NEWS

RACIAL DIFFERENCES

Science Service

EVERY one from the blondest Nordic to the darkest son of Africa had some stake in the symposium on the mental difference of races at the joint meeting of the Psychological and Anthropological Sections of the British Association for the Advancement of Science on August 11. Professor William McDougall, of Harvard University, advanced the theory that wide differences existed in the mental traits exhibited by racial groups as well as individuals. The psychoanalysts, Freud and Jung, go so far as to assert that each race has a mind-pattern of its own, using mental symbols typical of and peculiar to itself. Professor McDougall defined his own opinion as "the more conservative view" that races differ mainly in the strength of certain instinctive tendencies. We can not define very exactly in what "general intelligence" consists or describe in what manner it is inherited, but this gives us no warrant to deny or ignore the results of numerous tests which clearly indicate that racial mental differences exist.

Miss May Bere reported the results of some observations made on American children of south Italian, Bohemian and Russian Jewish parentage. A variety of intelligence tests, with due allowance made for the language difficulty and other interfering factors, showed the Hebrew and Bohemian children close together in their "intelligence quotients" and both considerably above the southern Italians. The investigation also showed very little correlation between the length of residence of the immigrant parents in America and the mastery of English by themselves or their children. Apparently the assimilation of the immigrant depends more on his individual ambition than on the time he has been in his new home.

Dr. F. C. Shrubsall, president of the Anthropological Section, endeavored to give some concrete illustrations of racial difference, although he admitted the difficulty inherent in the fact that no modern nation is of any single racial stock. He thought that the English could be classed as "tough minded," extravert, practical and inclined to think in concrete images and models, while German thinkers were more introvert and inclined to abstract ideas. This might be due to the "Alpine" racial element in Germany. Of the three racial elements in Europe commonly recognized by anthropologists he defined the tall, blond Nordics as "unemotional"; the dark Mediterraneans as "unrestrained emotional"; and the round-headed Alpines of eastern Europe as "restrained emotional," the "dreamy" type.

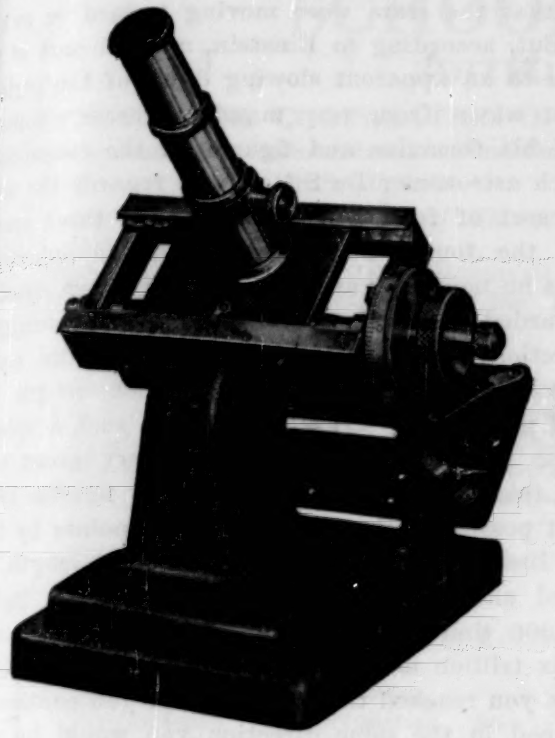
The majority of the speakers at the session questioned very strongly whether it were possible at the present time, in view of our imperfect racial classifications and the inadequacy of present mental tests to reach any definite conclusions as to "superior" or "inferior" races. Dr. Goldenweiser thought that unconsciously we graded other races by their degree of historical success, particularly in war, and pointed out how greatly we revised our opinion of Japanese mentality after the victory in Manchuria. The real differences in culture appear to be due not to differences in average ability, but to the achievements of a very small number of leaders of great genius. It is unfair to judge the negro by his failure to compete successfully with the white man in the United States without also taking into consideration the too frequent moral degeneration of the white man in Africa. Dr. H. Peake showed the difficulty in dealing with mental traits until the psychologists had analyzed them more exactly than at present. We call a people "thrifty," but just what is thrift? Of what elements of greed, caution, etc., is it composed?

Several of the speakers pointed out certain weaknesses of the intelligence tests as applied to widely different races. Dr. C. S. Myers instanced a group of Orientals, dissatisfied at their I. Q. ratings, who devised some tests of their own, suited to an Asiatic genius, and "flunked" the Europeans on it. Dr. W. D. Wallis showed how the negro in the favorable environment of the northern states had a much higher intelligence rating than the negro of the cotton belt. He warned against rash judgments of racial inferiority and asked his audience how a cultured Roman two thousand years ago might have judged their own barbarian ancestors from northern Europe. Dr. Sapir and Dr. Swanton (the latter in a written communication) pointed out the significant fact that where psychical measurements were most exact, as in testing sensory discrimination, the difference between races was found to be least. Dr. Sapir brought forward the interesting point that no intelligence test, not even the purely mechanical or geometrical tests which eliminate the advantage of familiarity with words and their use, could be quite impartial as between races of quite different backgrounds. The civilized man, for example, is from childhood trained to the use of exact geometrical shapes, just as the savage is trained to look for wild game, and so it is no wonder that he can recognize them more quickly and handle them more surely.

POPULATION AND INTER-RACIAL PROBLEMS

Science Service

THE population of the world is rapidly reaching its limit and the struggle for expansion, which was the ultimate motive of the world war, will inevitably be still more bitter and terrible if it becomes the struggle for existence between white and colored races. This is the conclusion of Professor J. W. Gregory, expressed in his address as president of the geographical section of the British Association for the Advancement of Science. If population increases as it did in 1906–1910, there would be as many people as the world could feed in 120 years, and even if the food supply should be indefinitely multiplied, there would be standing room only, on land outside the



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polar regions, by the year 3,000. There is a double menace in the race problem. We are warned from one side of the danger to civilization of the rising tide of color and from the other of the peril to humanity from the rising tide of color prejudice. A thousand years ago the whites held only part of Europe. Now Europeans, though only a third of the world's population, rule eight ninths of the habitable land. But during the past half century colored races have increased faster than the white. Increased disparity in numbers means, in a democratic age, an inevitable transfer of power; while the former prestige of the white man has been undermined by his own beneficent rule. Alike in war and peace the personal authority which the white man held in 1900 has undergone a momentous decline. African negroes are increasing faster than any other people in the world. South America is firmly held by a mixed race, and Professor Gregory thinks it most probable that a similar hybrid race will eventually occupy the southeastern section of the United States with some measure of home rule. The whites can only hope to hold in South Africa certain segregated sections and in Asia only the north and northwest. White colonists have no chance of permanently occupying land near the overcrowded parts of Asia or accessible to the fast multiplying negroes of South Africa. White merchants may find in these regions profitable trading centers and may for a time rule and administer them, but when white enterprise has subdued the land, built railways and utilized the rivers, the colored man will oust the white from all but the few posts that require experts. But Australia may be completely colonized by the white race for the speaker believes that the conquest of tropical diseases will enable the tropics to support white civilization. Australian experience has proved that even in the hot and humid climate of Queensland, sugar cane plantations can be more successfully worked by white than by colored labor. Black men can usually stand more heat than white. Professor Gregory looks to segregation as the best solution of the race problem for he does not believe in interbreeding and regards coresidence as incompatible with racial integrity and the highest development of either race. "The affectionate, emotional negro, the docile, diligent Asiatic and the inventive, enterprising European, do not work at their best when associated in mass."

THE MEASUREMENT OF THE UNIVERSE

Science Service

THE universe is finite and measurable. So said Einstein, and now Silberstein has measured it. Space is boundless and yet limited. The radius of the universe is one hundred and fourteen million light years. In a paper read at the Toronto meeting of the British Association for the Advancement of Science by Ludvik Silberstein, of Rochester, this result was deduced from the observed shift toward the blue and toward the red of the spectrum lines of sixteen globular star clusters, two Magellanic clouds and one nebula, which are among the most distant objects visible, all over thirty-three thousand light-years away. Such a shift, called the Doppler effect, has been interpreted by astronomers as indicating that the stars were moving toward or away from us. But, according to Einstein, a small part of it may be due to an apparent slowing down of the period of the light waves from very massive sources. Silberstein based his formulae and figures on the conception of the Dutch astronomer De Sitter, who regards the universe as a sort of four-dimensional sphere, three space dimensions, the fourth being time. Such a spherical universe has no boundary and any point in it can equally well be regarded as the center. Lines start out straight in all directions from a point extended to the most distant plane, called the polar, and then return to the original point. The straightest line in such a spherical universe is a closed curve and of very great but still finite total length. Dr. Silberstein figures that the greatest possible distance between two points by the straightest line, which is one half that total length, is one hundred and eighty million light-years. A light-year is 63,000 times the distance of the sun from the earth, or six trillion miles. You would not run against a wall when you reached that limit, but if you continued straight ahead in the same direction you would be approaching your starting point from the other side.

These ideas seem strange as applied to the universe yet they are familiar as applied to our earth. The earth's surface is unbounded yet finite and measurable. The straightest line on the earth is a great circle. Start out from any point in any direction and travel as straight as you can and you can never get more than twelve thousand miles away, if you walk farther in the same direction you get nearer home. The earth's surface has no end and no center, for it is curved spherically in the third dimension. Like the earth, the universe is not a perfect sphere but is slightly irregular, corrugated as it were, owing to the gravitation of the matter it contains. The length of the radius of curvature of the universe in miles, as calculated by Dr. Silberstein, is represented by the figure sixty-seven followed by nineteen zeros.

JAWS OF FOSSIL APES

Science Service

THREE lower jaws of fossil apes, found in the Siwalik Hills of India, were presented to the British Association for the Advancement of Science by Professor William K. Gregory, of Columbia University, as relics of a common progenitor of apes and man. They belonged to an extinct creature, about the size of the chimpanzee, picturesquely named "the ape of the oakwood," or, in scientific parlance, Dryopithecus, who lived in the Miocene epoch some three or four million years ago. The Siwaliks of the Himalayas was in those times a great breeding ground of such anthropoid apes whose bones show such similarities with those of orangs, chimpanzees, baboons, gorillas and men as to indicate that they were close to the ancestral type. These jaws were discovered by Dr. Barnum Brown, of the American Museum of Natural History, and the crown pattern of the anterior

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molars falls in between the type of the chimpanzee and the human bicuspids. These new discoveries give support to Darwin's view of the descent of man from the anthropoid stem and they also give a date, the Miocene of the Age of Mammals, after which distinctly human characteristics began to develop. Professor Gregory said: "Darwin's conclusion that mankind has sprung from some early member of the anthropoid division of the Old World primates could be supported to-day by the citation of an enormous mass of independent testimony gathered from very many special fields. In whatever direction competently trained investigators have worked, they have uncovered more and more the all-pervasive, structural, physiological and psychical kinship of man with even the existing anthropoids, in spite of their divergent specialization for far different modes of life."

ENCKE'S COMET

Science Service

ENCKE'S COMET, the most frequent of such visitors in the solar family, has been sighted at the Yerkes Observatory, according to telegraphic information received at Harvard and distributed to astronomers in America and abroad. This is the forty-second return of the comet since it was first discovered in 1786.

Encke's comet is remarkable for its short period of revolution around the sun—about three and a third years—and especially for the peculiar variations in that period. No other comet returns at such short intervals to the vicinity of the sun, though many of them make closer approaches. At its greatest distance Encke's comet is four hundred million miles from the sun, nearly out to the orbit of Jupiter. At perihelion, when nearest the sun, it is within the orbit of Mercury, about thirty million miles from the sun's surface.

Though discovered and lost two or three times in the eighteenth century, it was not until about one hundred years ago that Encke's mathematical studies connected the various discoveries and revealed the nature of the orbit and period. The investigations by Encke and later astronomers showed that, after making allowance for the perturbing effects of near-by planets, the period of revolution is continuously decreasing by approximately two and a half hours each revolution. Russian astronomers in particular have paid close attention to this unprecedented behavior.

The only satisfactory explanation is that the comet is hindered by obstructing matter as it moves through space. The resisting medium acts in a somewhat paradoxical manner. The comet tends to fall toward the sun when its motion is hindered, taking up a new position where the natural speed is greater. The obstruction, therefore, makes the comet go more rapidly and shortens its period of revolution. Whether this resisting medium is of the nature of a swarm of meteors, or is material more uniformly distributed throughout space, astronomers can not tell. Other comets, however, have not suffered such pronounced changes of period, suggesting that the disturbing factor is not wide-spread throughout the solar system.

Encke's comet is not likely to be a conspicuous object on this visit, for it is one of the smaller bodies of its kind. It very frequently misses discovery upon its return to the neighborhood of the earth and the sun. At its present approach, when it was photographed by Professor Van Biesbroeck with the Yerkes reflector, it was of the sixteenth magnitude, therefore visible only with the greatest telescopes. It was then about five degrees southwest of the Pleiades.

Its motion will be followed in order to throw more light on the change in its period and on the unexplained resisting medium in the solar system.

ITEMS

Science Service

THAT the pronghorn antelope, lately considered doomed to certain extinction, may yet be saved is the encouraging word that comes from the government naturalist at Yellowstone National Park. One of the most beautiful and graceful of American game animals, it was also at one time most abundant, its vast herds on the western plains outnumbering even the bison. But the same fate overtook it that befell the bison, and now its numbers are reduced to a few thousands in the American northwest and in Canada. Part of the surviving herd is protected in Yellowstone Park. Hunting the pronghorn has long been prohibited generally, but predatory animals, especially coyotes, still kept their numbers down. Recent intensive campaigns against the coyote in the park seem to have had beneficial results, and the antelope herds are again on the increase.

TREES can't breathe smoke and be healthy. Such has been the experience, at least, of the St. Louis municipal park department. Efforts to establish trees within the smoke area created by the industries of the city, which includes some of the most prominent public buildings, are proving failures. Sycamores and poplars, supposedly smoke resistant, succumb within two or three years. The only tree which seems to thrive in such localities, a veritable child of the slums as it were, is the tree-of-heaven, or ailanthus. Shrubs show much the same tendency. Privet has proved the most resistant—but even this is dying out. Lilacs, when they live, seldom bloom. Blue grass lawns are impossible except for a short period in spring.

AN appreciable lessening in the cost of certain forms of mining in the United States may result from studies now being conducted by the Bureau of Mines on the use of liquid oxygen explosives. These can be manufactured at the mine with the same power plant used for other operations so that the high costs of transportation for other explosives may be eliminated. The experiments to date indicate that liquid oxygen explosives can be used in iron, salt and other mineral mines and quarries. They probably can not be used safely in dusty and gaseous coal mines. G. St. J. Perrott, associate physical chemist on the staff, has been sent to Pachuca, Mexico, to study the use of these explosives in the large silver-lead mine there.

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SCIENCE NEWS

RESPIRATION IN PLANTS

Science Service

PLANTS breathe with their feet as well as with their heads, and there is oxygen enough in good garden soil for their needs. These are discoveries of Professor Burton E. Livingston, of the Johns Hopkins University, and Dr. Lee M. Hutchins, of the U. S. Department of Agriculture, working in the former's laboratory of plant physiology.

Earlier work by these men and by other scientists had already established the fact that plants must get their oxygen through their roots as well as through their leaves, and that air taken in through the top of the plant does the roots little or no good in most species. It has, of course, been long observed that many kinds of plants "drown" when they stand for a considerable period of time in flooded land, even though their tops may be above the water. This "drowning" of a plant is exactly like the drowning of a man: both die of suffocation, or lack of oxygen. That the plant has its head above water does it no good; it has no lungs or circulatory system to pass the air down to its roots, and if they can not get oxygen from the soil they can not get it at all.

Livingston and Hutchins then proceeded to develop a most ingenious method for measuring how much oxygen the soil can supply in a given time. A cone-shaped filter of thin porous porcelain is sunk into the soil to be studied, and allowed to remain until the earth settles around it. Then nitrogen, from which the last trace of oxygen has been extracted, is fed slowly through from a storage tank, and as it passes out again is run through a sikytu solution of pyrogallol, a chemical that turns brown in the presence of oxygen, and can be used to measure the amount that has come in through the walls of the filter.

By this method it was found that three factors influence the rate at which oxygen can pass through the soil to the roots of plants. Tightly packed soils can supply little oxygen, while well-cultivated soils pass it through easily. The rate of supply depends also on the amount of water present: the more nearly waterlogged the soil the lower the rate of oxygen movement. Finally, the deeper the soil level the slower is the rate of supply.

The natural distribution of plants is governed at least in part by the amount of oxygen their roots need. Plants of wet habitats, like rice, willows and cattails, require little oxygen for their roots; corn, potatoes and other crops of well-cultivated lands require a great deal. Ordinary forest trees for the most part occupy an intermediate position. It is expected that the new method will in time yield data of great value in botany, agriculture and forestry.

ACTIVITY OF KILAUEA VOLCANO

Science Service

THE Hawaiian volcanoes are popularly supposed to be the most placid in the world, but they sometimes belie their reputation. Kilauea volcano on the eighteenth of May of this year produced an explosive eruption quite comparable to those of Vesuvius.

This was not wholly unforseen, for we know that natives were killed by a blast from Kilauea 134 years ago. It is known also from Japanese statistics that 130 years is a critical interval between eruptions of many volcanoes, and a suspicion that this might apply to Kilauea led us in 1918 to publish a warning that about 1920 might be a dangerous time.

The warning was abundantly justified. The year 1920 produced tremendous lava flows, for the next four years the lava sank lower and lower within the mountain, and in 1924 the famous fire pit of Kilauea collapsed violently so as to plug the accumulated gases beneath, and a terrible explosion ensued.

We do not yet know the cause of such explosions, but there is much evidence from observations made during the last ten years to justify the working hypothesis that the lava sank so low as to let the rain water underground close over the crack containing the glowing slag. There is everywhere a great sea of underground water in all lands. In Hawaii the rocks are so porous that this water stands inside the island at a very low level, so low that it can not be reached by ordinary wells, but flows out as sea-level springs. Ordinarily the lava column at Kilauea crater must cover itself with a shell of hardened slag in the shaft beneath the volcanic vent, and keep the water out by evaporating it with its heat.

This year, however, there was a swarm of earthquakes in Puna, at the east end of Hawaii. The ground cracked open in huge crevasses, as though a lava flow were going to break out at sea level. The ground, however, subsided. Then the fire pit 3,700 feet higher near the summit of the mountain began to cave in, great black clouds of avalanche dust shot upwards, the pit grew bigger and bigger, steam appeared, and then the black clouds growled and roared and hurled out huge broken rocks without a particle of fresh lava. It was just as though the pit had been converted into an upright quarry with big blasts let off at intervals of about six hours. Boulders weighing ten tons were hurled hundreds of feet from the explosion center. Dust curdled into rain clouds and came down as mud balls. Gutters on the hotel roofs broke down with the weight of rock powder. A man trying to photograph the pit at close range was killed by a barage of boulders. The eruption lasted two weeks and the great cauldron left was 3,500 feet long and 1,300 feet deep.

All the other activities of Kilauea have shown fresh black glassy lavas and so do the other Hawaiian volcanoes in most of their eruptions. Until last February the fire pit was full of boiling lava fountains. The succession of events since 1914 has been: Outpouring of lava at 13,000 feet above the sea, then 8,000 feet, then 3,000 feet and finally this inpouring at sea level itself. It seems logical to conclude that such explosive eruption is a secondary matter occasioned by the plugging of the vent, the closing in of the underground waters, and the

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consequent development of enormous steam pressure. The interesting feature of this is that the water explanation accounts, not for ordinary lava activity, but only for the exceptional crises of explosion. Explosive eruption at a lava volcano is a secondary phenomenon, and primary volcanism may be fundamentally dependent on hydrogen and other deep gases.—T. A. Jaggar, Jr.

GIANT STARS OF THE MAGELLANIC CLOUDS

Science Service

THE most conspicuous stars in the Magellanic Clouds are greater in size and in brightness than any of the giant stars heretofore known to astronomers, according to investigations just announced by Dr. Harlow Shapley, director of the Harvard College Observatory. Many of these stars are believed to excel the far-famed red giants Betelgeuse and Antares, and in diameter probably approach the diameter of the orbit of Jupiter, some 966,600,000 miles.

Extensive photometric work has led finally to the determination of the distance of the Small Magellanic Cloud. Similar investigations are under way for the Large Cloud. These stellar systems, which are visible only in southern latitudes, derived their name from descriptions given four hundred years ago by the navigator Magellan. They look like large patches of the Milky Way, but are quite detached from the Galaxy.

Through a prolonged study of the variable stars discovered in the Magellanic Cloud by Miss Leavitt at the Harvard Observatory twenty years ago, a method has been developed for the determination of the distances of star clouds and clusters. Only this year, however, has it been possible to give a decisive value for the magnitudes of the stars in the Small Magellanic Cloud, and consequently to measure the distance and dimensions of the system. It is now found that the diameter of this cloud is sixty-five hundred light years. The distance from the earth is thirty-two kiloparsecs, which is equivalent to a little over a hundred thousand light years. A study of the luminosity of our sun would at this distance be of the twenty-third magnitude.

Stars as faint as our sun in this cloud, however, are far beyond the range of modern telescopes. The studies of brightness on the Harvard photographs, which were made at the Arequipa station in Peru, go down only to the stars of the eighteenth magnitude.

More than half a million stars that are at least a hundred times as luminous as our sun are contained in the Small Magellanic Cloud. A few hundred of them have each more than ten thousand times the solar brightness. The very brightness of the super-giants are shown by photographs of their spectra to be of the redder classes of color. Hence the intensity of light emission must be low, and, to account for such high total brightness, the dimensions must be exceedingly great. It is calculated that the diameters of the largest supergiants are nearly a thousand million miles. This is at least three or four times the diameter of Betelgeuse, and is probably very near the maximum diameter possible for a luminous star.

The Small Magellanic Cloud is known to be receding from the Galaxy with the enormous velocity of a hundred miles a second. Dr. Shapley points out that almost certainly both the clouds of Magellan were in the Milky Way at a time more recent than the paleozoic era, and were then indistinguishable from the other star clouds of the Milky Way.

THE "PLANETARIUM"

Science Service

AN instrument that is expected to have a great influence on the teaching of popular astronomy has been installed at the German Museum of Natural Science and Technology at Munich. It is the product of the optical firm of Zeiss, and has been under construction for five years. The chief advantage of the machine lies in the fact that it substitutes a realistic and accurate picture of the happenings in the heavens for a confusing arrangement of wires and wooden balls heretofore used.

The "planetarium," as the instrument is called, is of unusual, even weird and startling, appearance. There is something about its general make-up that would suggest a small anti-aircraft cannon, but instead of ending in a long barrel, it has as its most essential part a large sphere studded with high-power lenses, resembling a gigantic insect's eye. Each of these lenses is arranged to project the image of a certain part of the heavens, so that the whole starry universe can be made to march across the dome-shaped ceiling of the "sky room" where the planetarium is housed.

All stars down to the sixth magnitude are shown, as well as the milky way, the planets, the sun and the moon, The instrument can be rotated at any speed, showing the celestial events of a day in a period of four minutes, or crowding a year into fifty seconds. Within the artificial sky of the planetarium study, the operator has the power of a Joshua; for he can bid the sun and moon to stand still, and cause the stars to run backward in their courses. So accurate is the instrument that after rotations representing five thousand years there is an error of less than two degrees.

AN AUTOMATIC REGULATOR

Science Service

A MECHANICAL device so sensitive to pressure that the breath of a child directed into a funnel can release enough power to lift many tons of weight, and so sensitive to temperature that the heat coming from a man's hand held near a metal strip will effect the same result, has been perfected in Sweden after three years of experimentation and through tests in actual use.

This remarkable multiplication of power is, however, only an incidental feature of the apparatus, which takes the place of a man in an industrial establishment opening and shutting all sorts of regulating valves automatically and with an accuracy that no human being could ever achieve. The new apparatus can, for example, keep the temperature of a room within a quarter of a degree of the value desired, and can keep steam pressure from changing more than two ounces per square inch. It can also regulate electric current, speed, dampness or dryness, density of liquids, viscosity and vacuum.

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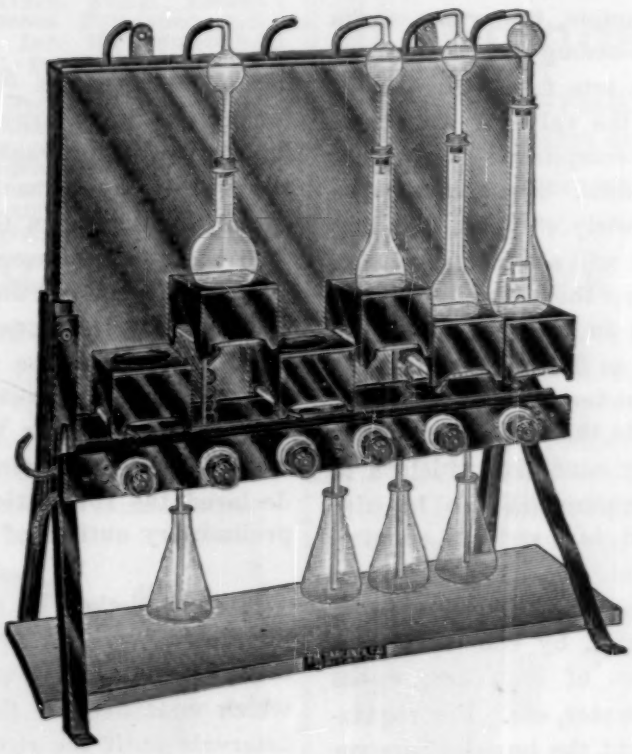

This distilling outfit is arranged in such a way that flasks of almost any size or style may be used as the heaters are adjustable for height. As illustrated, the battery of heaters is supplied with individual snap switches so that any or all units may be used independently. If desired, the snap switches may be omitted when all the heaters will be in operation at one time. This arrangement reduces the cost slightly.

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This new regulator, which was invented by the Swedish engineer, Ragnar Carlstedt, is based on one of the simplest of all mechanical principles, namely, the harnessing of a flowing current of water. In other words, if it is desired to open or shut the valve of a steam radiator in a room, this work is done by turning on water pressure from one of the water pipes of the house, instead of turning the valve by hand.

But how does the regulator know when and how to turn this valve? The operation of the apparatus may be explained as follows: A thin strip of ebonite, which contracts or expands under the slightest change of temperature, is so mounted that any change in its length moves a lever up and down. Meanwhile a jet from the water current already referred to is constantly playing against the moving end of the lever, which really acts as a lid over the jet, hindering its free flow more or less. If the jet is completely stopped, for example, the water backs up in the pipe until the pressure is strong enough to open a little valve, and this little valve sets free a current of water sufficiently strong to work the valve of the steam radiator. This final work is accomplished through a simple piston and cylinder mechanism. Even though the playing jet of water be not completely stopped, but only hindered in the slightest degree, it will set into operation a corresponding degree of power, thus regulating the steam radiator valve just enough to raise or lower the temperature of the room as little as desired.

Whatever use the regulator is put to its main operating mechanism remains the same, while the so-called impulse receiver is adapted to the force or condition which is to be regulated. For steadying temperature the impulse receiver, as we have just explained, is a strip of ebonite. For maintaining an even amount of dampness in a tobacco factory, for example, a band of cotton threads takes the place of the ebonite, and, by contracting or being extended under the changes of humidity, works the lever which hinders the jet of water, etc. For regulating steam pressure in a power plant the impulse receiver is a cylindrical copper bellows which is connected with the steam pipe in which the pressure is to be regulated.

THE FIXATION OF ATMOSPHERIC NITROGEN

Science Service

A NEW process for the fixation of atmospheric nitrogen in a form so it can be used for fertilizers or explosives was explained before the chemical section of the British Association for the Advancement of Science by W. A. Bone, professor of chemical technology, at the Imperial College of Science, London. Nitrogen is naturally a very inert gas and it is difficult to get it into an active state so it will combine with other elements, such as oxygen or hydrogen. In the commercial processes an electric spark or a metallic catalyst is used to get the nitrogen to enter into combination. But Professor Bone finds that nitrogen can be activated by proximity to carbon monoxide in combustion under pressure. Carbon monoxide can easily be procured in quantity from blast furnaces or by passing air through a bed of red hot coal. When this gas is put together with air into a bomb under a pressure of a hundred atmospheres and the mixture exploded, the carbon monoxide unites with the oxygen of the air to form carbon dioxide. But when this combination takes place under such circumstances the heat produced by the combustion is of such a quality as to be absorbed by the nitrogen molecule and set it into such an active state that it will in turn unite with other oxygen molecules of the air. This combination produces oxides of nitrogen from which nitric acids or nitrates of any sort can be readily derived. The nitrogen can be excited by the explosion or mixture of carbon monoxide, and air combines with oxygen more readily than does nitrogen which has been raised to a correspondingly high temperature by exploding a mixture of hydrogen and air.

ITEMS

Science Service

NATIONS with large unmapped areas will be urged to hasten their topographical work so that the resources of the world may be more fully understood, in a proposal which the American Geophysical Union will present before the geenral assembly of the International Geodetic and Geophysical Union at Madrid in October. Geophysical investigations are hampered greatly in countries which have not been mapped topographically. Further international cooperation in determining the configuration of ocean basins will be discussed by the union. A more accurate knowledge of the bottom of the sea is declared the foundation of all future geophysics in the preliminary outline of the discussion.

A NEW method of combating the weeds in California rice-fields has been worked out at the California Experiment Station at Cortena. The old method of irrigation, which consisted in flooding and draining the land at intervals until the rice was well sprouted, permitted the weeds to get a start as well, and like the corn and the cockle in the parable they grew together until the harvest—with the weeds having decidedly the better of the argument. But rice seed will germinate under water, and weeds will not; so the rice growers of the region are now flooding their land to a depth of four to eight inches at the very outset and leaving it that way, with the result that the rice thrives and the weeds perish.

AT least 34 eye defects are hereditary. At least eight of them are apt to produce practical blindness. From 5,000 to 7,500 persons in the United States now are blind from hereditary defects and their care costs more than $2,000,000 a year, it is estimated. These figures are obtained from the report of the committee on hereditary blindness of the American Medical Association, which has studied the subject for the past three years. The committee suggests a legal requirement that persons afflicted with hereditary eye defects be required to give bond at the time of marriage sufficient to cover the cost of caring for possible children who might become burdens on the community.

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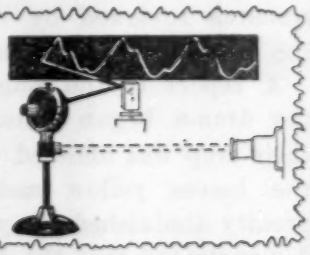

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SCIENCE NEWS

ISOLATION OF VITAMIN A

Science Service

THE Chemical Society of Japan announces what they believe to be Vitamin A has been successfully isolated by two Japanese chemists, K. Takahashi and K. Kawakami. If this actually has been done it is likely to prove an important event in the progress of food chemistry.

Vitamin A, the fat soluble vitamin, is perhaps the most important of these mysterious substances now definitely known to exist. Its absence in food gives rise to rickets in children. It is closely connected with the growth of children and young animals. It is abundant in butter, egg yolk, cod liver oil, milk, cream and most oily animal fats. Certain fresh vegetables, such as cabbage, spinach, tomatoes and lettuce, have some of this vitamin. Long exposure to heat gradually destroys it, but ordinary cooking seems to have no effect.

Hitherto nothing has been known concerning its chemical structure and very little about its properties. The Japanese chemists, however, have analyzed the substance they obtained. Whether or not it is vitamin A remains a question for further verification. They isolated it from cod liver oil, butter and egg yolk. After an involved chemical process a semi-crystalline substance was obtained, constituting about one tenth of one per cent. of the original material. This was found to be composed of carbon, hydrogen and oxygen, with no nitrogen. A mouse at the point of death because of lack of vitamin A was given minute quantities of the substance daily and in ten days was restored to complete health.

Vitamin A has been considered in the nature of a catalyst, an agent with the power of bringing about extensive chemical changes without being itself altered in the process.

PINEAPPLES AND IRON

Science Service

PINEAPPLES with leaves pale and anemic for lack of iron, starving for iron though there was plenty of it in the soil, and cured finally by being sprayed with an iron solution, are actors in a strange romance of botanical research reviewed by Dr. William Crocker, director of the Boyce Thompson Institute for Plant Research.

A report to the Engineering Foundation states that the drama began when pineapple planters found that their crop was afflicted with a strange disease that made the leaves yellow and sickly-looking and of course greatly diminished the yield. Plant physiologists quickly demonstrated that the disease was simply iron starvation —for plants must have iron to make their leaves green just as animals must have it to make their blood red.

But chemical analyses showed that there was plenty of iron in the soil, also great quantities of lime, which had always been supposed to be "good for plants." Then followed the discovery that if there was too much lime the iron was not sufficiently soluble for plants to get it. The lime locked the iron up. Where the soil contained a great deal of manganese the story was the same. And since the two principal pineapple-growing regions under the American flag were thus afflicted—Porto Rico with too much lime, Hawaii with too much manganese—the situation looked serious.

Then a researcher for the Department of Agriculture, working in Porto Rico, found that these sick pineapples could be made healthy again by spraying their leaves with a solution of iron sulphate. Fifty pounds per acre, sprayed on the leaves, effected a complete cure; although 3,000 pounds per acre applied to the soil made no difference whatever—the lime took it all.

The new method of assuring that pineapples "have their iron" at regular intervals has greatly increased the pineapple yield in both Porto Rico and Hawaii. The export of canned fruit from the latter region has exactly doubled.

This method of distributing iron by spraying has lately come to have other applications. In many federal pine tree nurseries in the west, where alkaline soils are common, the seedlings developed the same iron-starvation symptoms, which have been successfully overcome by iron sulphate sprays.

Directly or indirectly, animals and men get most of their salts from plants. A few years ago on certain pasture lands of New Zealand, sheep and cattle developed "bush sickness." This was an iron-deficiency disease. It was later found that if the plants in these pastures were sprayed with iron sulphate and certain other salts, the sickness disappeared.

AMERICA'S FIRST AIR LINER

Science Service

AMERICA'S first giant, passenger-carrying airship, now being prepared for its trans-oceanic flight from Friedrichshafen, Germany, to Lakehurst, New Jersey, may be sent across the continent soon after its delivery to the United States, according to tentative plans under consideration by the Navy Department here. Mooring masts for the accommodation of the big aerial liner have been erected at Fort Worth, Texas, San Diego, California, and Camp Lewis, Washington.

Before starting this more protracted cruise, short trips will probably be made from Lakehurst to determine the exact difference in behavior in the air of the new commercial ship as compared with the *Shenandoah*.

The new ship is not a sister ship of the American-built *Shenandoah*, designed in 1916 as a military auxiliary. The ZR-3 is strictly a peace-time air liner with Pullman accommodations for twenty passengers, especially designed in 1921–22 to meet the requirements of greater safety and comfort demanded of a commercial craft. It will be used to test the commercial possibilities of lighter-than-air traffic. Hydrogen gas will be used by the Germans in their flight across the Atlantic, but the ZR-3 will be converted for the use of helium after it is received by the navy.

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The ZR-3 is larger and faster than the *Shenandoah*, although not so long. It measures 658 feet in length, whereas the *Shenandoah* measures 680 feet. Its diameter, however, is 91 feet as compared to 78 feet for the *Shenandoah;* making it somewhat stockier and giving it a greater gas capacity, 2,400,000 cubic feet as compared to 2,115,000 cubic feet.

The passenger ship is equipped with five twelve-cylinder 400 horse-power Meybach direct reversing motors which will drive it at a top speed of 75 miles an hour, whereas the five six-cylinder 250 horsepower Packard engines of the *Shenandoah* give it a top speed of 60 miles an hour. At 75 miles an hour, the ZR-3 can go 4,000 miles without refueling and at 60 miles an hour can go 6,000 miles. She carries a crew of 44 besides her twenty passengers. The *Shenandoah* has a crew of 31.

CARBURETOR ADJUSTMENT

Science Service

THE average motor vehicle wastes about 30 per cent. of the heat value of the fuel used through improper carburetor adjustment.

Such is the conclusion reached by scientists of the United States Bureau of Mines as the result of a study of the efficient utilization of gasoline. The figures were obtained largely by measuring and analyzing the exhaust gases. The waste was found in the production of incomplete combustion products—carbon monoxide, hydrogen and methane. Loss of heat value, the bureau points out, means also loss of mileage. By properly adjusting the carburetors for maximum power and efficiency a large part of this heat loss can be eliminated. The experiments were carried on with a number of different fuels.

Among the practical conclusions reached by the bureau are: (1) Change the carburetor adjustment when shifting from low-test to high-test gasoline. (2) Set the carburetors at a leaner adjustment for benzol fuels than for ordinary gasoline. (3) Use a preheater only when necessary, that is, only with gasoline which will not give satisfactory operation without preheated air during cold weather or for the first half hour after the engine has been started and before it is thoroughly warmed.

LEAD-EATING INSECTS

Science Service

How to get the better of an insect that eats holes in lead-covered cables and causes as much as one fifth of all wire troubles encountered by telephone companies in certain parts of the United States is the problem which is now being attacked by entomologists of the U. S. Department of Agriculture.

The insect is small and inconspicuous enough, being a stocky little black beetle about three sixteenths of an inch long, with a square-cut, blunt head and jaws very powerful for their size. It attacks the lead cables mainly where the suspension rings give it a foothold and permit the accumulation of moisture. Since its normal food is wood, particularly oak, it is difficult to understand why it should choose such an unnutritious variation in its diet; though some have conjectured that it is after the insulating material inside, which may possibly be appetizing to an insect.

Efforts to stop the depredations of the beetle have not so far met with much success. Nothing seems to be able to stop its gnawing jaws except steel, and nothing seems to be poisonous to it. Lead arsenate, creosote, carbolineum, copper, nicotine sulphate, sodium silicate, naphthalene (moth ball) compounds, spar varnish, and a number of other materials were tried as protective measures, and the beetle calmly ate through all of them with good appetite.

The lead-boring beetle has a number of other insect relatives who turn aside occasionally for a snack of something really worth chewing on. Representatives of at least half a dozen families have been found going through such things as tin, zinc, silver, asbestos, the gilding on chandeliers, and the mercury coating of mirrors. Bugs sometimes go in for a chew of plug tobacco, but they are the mollycoddles of really tough six-legged society.

THE BURSTING POWER OF HYDROGEN GAS

Science Service

HIGHLY compressed hydrogen gas has a tremendous bursting power all out of proportion to its pressure, according to Dr. P. W. Bridgman, of Harvard University, in a recent report to the American Academy of Arts and Sciences.

A chrome-vanadium-steel cylinder in preliminary tests withstood the enormous pressure of 160 tons per square inch, but succumbed to only 60 tons pressure when hydrogen was doing the work. Hydrogen is the most finely divided form of matter known. Apparently its extremely small molecules squeezed their way amongst the steel particles and demolished their structure.

At these excessive pressures the repulsion of hydrogen molecules of each other becomes stupendous. In Dr. Bridgman's experiments hydrogen even at the highest pressures could not be concentrated into a form as dense as common cork. At 60 tons pressure a quart of the gas weighed only three ounces—a fair rating for a quart of feathers not too well packed. It required over 90 tons pressure to force the molecules together shoulder to shoulder, that is, barely to eliminate the empty space which normally constitutes most of the volume of a common gas.

All known laws of gas pressure familiar to gas engineers break down at the extreme pressures of Dr. Bridgman's experiments. As was anticipated, it was not found possible to liquefy hydrogen by pressure alone, despite the fact that the pressure of 90 tons per square inch was able to pack the gas into half the space that the substance occupies as a solid under conditions of extreme cold.

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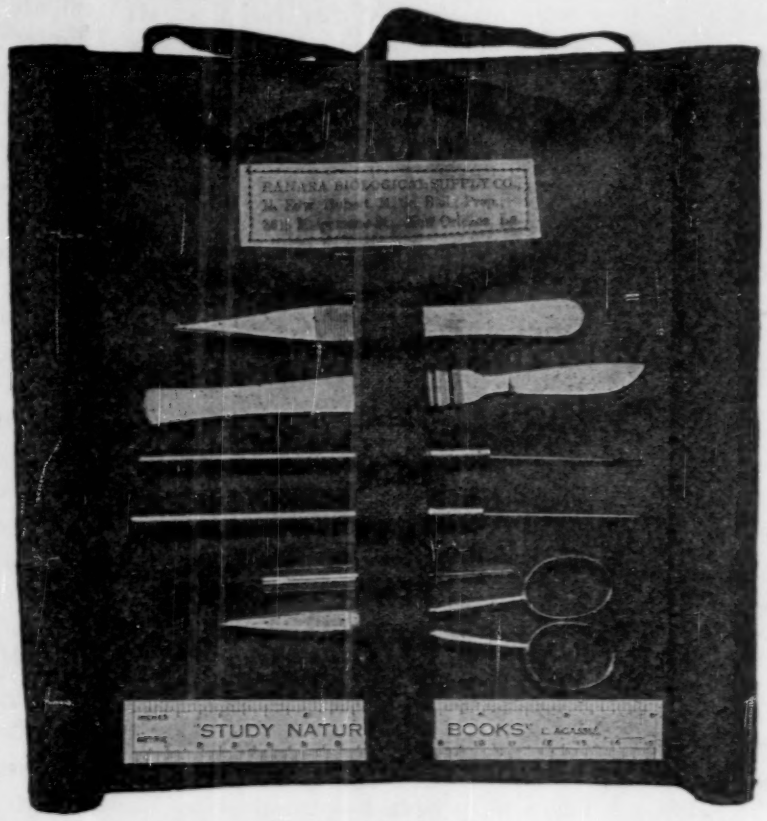

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THE DEATH RATE

Science Service

THE first half of 1924 has probably registered a lower death rate than was ever experienced for the first six months of any year in the history of the United States and Canada. This is indicated by the mortality records of the industrial policyholders of the Metropolitan Life Insurance Company, by its statistical department which has completed an analysis of the data.

After an uninterrupted rise for four years, a decline in the diabetes death rate began coincident with the increasing use of insulin in 1923. For the first six months of 1924, the fall amounted to 27.5 per cent., among the white policyholders and to more than 10 per cent. among the colored. Although there is, as yet, no positive proof that the reduction is the direct result of the increasing use of insulin, there is good reason to hope that the two phenomena are connected.

The cancer death-rate was a little lower than that in evidence at this time last year. The death-rate from alcoholism declined slightly. Deaths from acute poisoning by wood and denatured alcohol appear to be decreasing in the industrial population. Fatal accidents showed a little more satisfactory record. The death rates from automobile fatalities continued to increase—only slightly among the whites but about 10 per cent. among the colored. There have been fewer suicides.

The typhoid fever rate is still falling and there is promise that a new minimum will be registered in 1924. Diphtheria mortality in the industrial population has been running lower than ever before. Scarlet fever and whooping cough, it is true, show practically the same death rates as for the corresponding period of last year. however, this really indicates improvement, in view of the much greater number of infant lives exposed to risk and covered by the data this year. There has been no general prevalence of epidemic influenza thus far. The mortality from lobar pneumonia decreased markedly among the white policyholders and slightly among the colored. Bronchial pneumonia caused more deaths than during the same period of last year; but this, again, was due to the relatively high number of infants concerned. An increase in the rate for diarrheal diseases is explained on the same ground. The mortality from diseases incidental to pregnancy and childbirth declined among white women, but this improvement did not obtain for colored women.

MERCURY BOILERS

Science Service

THE value of boilers using mercury vapor in the place of steam in power plants is justifying all expectations, according to a statement by Dr. W. L. R. Emet, consulting engineer of the General Electric Company, addressing the World Power Conference in session at London. The efficiency of mercury vapor for developing power lies in its use of extremely high temperatures without excessive pressure and its adaptability to turbine engines. Also the heat of condensation can be used for making steam for auxiliary power or for other purposes.

The continued operation of a mercury boiler and turbine at the Dutch Point Station of the Hartford Electric Light Company has suggested modifications and improvements without developing additional difficulties. Special boilers and fittings must be used suitable to the temperatures used. Leakage of mercury and mercury poisoning appear to be entirely avoided. Repeated measurements of the fuel used and the energy delivered shows a saving of 50 per cent. in fuel with the mercury engine, together with other advantages of reduced space occupied and amount of water required. Mercury power is well adapted to locomotives and boats. The studies indicate a saving of 60 per cent. in fuel with inprovements based upon the experience acquired at Hartford.

The supply of mercury for the increased demand which may follow a more general use of mercury for power purposes does not seem to be limited. Abundant sources of mercury are known and require only a slight rise in price to bring it upon the market, and other sources of supply will doubtless be revealed.

ITEMS

Science Service

THE Chinese starling or crested mynah, perhaps the largest and most beautiful of the wide-spread starling family, has obtained a firm foothold about Vancouver, B. C. The certainty that this oriental visitor will extend its range has caused considerable anxiety along the Pacific coast for, like all starlings, it has a reputation for raiding fruit orchards. The bird now has a radius of about 50 miles about the Vancouver water front. It is advancing in all directions about a mile a year, according to local bird students. An individual specimen has been noted as far south as Portland, but it is not certain that this was not an escaped cage bird. This starling is about the size of a robin with a yellowish white bill overhung by a fan-like crest. Its glossy black plumage is in striking contrast with a large, white marginal wing patch. It makes a god pet, but in the wild state it is a marauder, and steals the eggs and nests of other birds. While little effort has been made to eliminate the visitor it is regarded as decidedly an undesirable by R. F. Butler, secretary of the British Columbia Game Conservation Board.

RAILWAY chemical engineers have produced a special lubricant from castor oil which is now being used with great success on the Chinese Eastern Railway. According to the traction department, it makes a most economical and efficient car lubricant. The manufacturers of this new oil have named it "Ricinol" from the scientific name of the castor oil plant (*Ricinus communis*). Castor oil is coming to be used most extensively for technical as well as medicinal purposes and in China it is also used as food. During the past few years there has grown up in Manchuria a demand for Ricinus seeds as well as for technical castor oil, which are exported to Europe. The seeds are extremely rich in oils, certain species containing up to 63 per cent. This demand for seeds has caused an increased acreage to be planted under the castor oil plant.

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SCIENCE NEWS

THE BOILING-POINT OF CARBON

Science Service

THE boiling-point of carbon is estimated at about 8,700 degrees Fahrenheit in a recent report to the French Academy of Sciences. This extreme temperature is considerably higher than figures hitherto accepted, and is the result of determinations of the vapor pressure of carbon at various stages of white heat.

Nobody has ever seen liquid carbon. When the substance is heated intensely, it sublimes out in the form of soot long before it could melt. If it were humanly possible to imprison a mass of carbon in a closed space at ultra-white heat, no doubt a fluid state would result. However, if the recent estimate is correct, there is little chance of melting carbon, as our powerful tool the direct-current electric arc itself does not exceed 6,500 degrees Fahrenheit even at the crater of the positive carbon.

Some scientists have claimed that carbon does not vaporize at all. In other words, the black smut on the glass of an old carbon incandescent lamp was supposed to be merely dust blown out from the white hot filament. The new experiments now show that this smut is finely crystalline, and resembles the filament no more than snow resembles the ocean, its original source. Thus the carbon must have evaporated and been redeposited.

There may be a planet somewhere in the universe where water has the same aversion to the liquid state which carbon has on earth. In a world whose atmosphere is rare enough to exert a pressure of only one ounce per square inch instead of fifteen pounds, liquid water is out of the question. There might be snow, hail, ice, or even steam, depending on the weather—but never a liquid.

THE BOUNDARY LINES OF THE CREEK CONFEDERATION

Science Service

THE Bureau of American Ethnology has set for itself the task of digging up the far flung boundaries of a vanished nation—one of the most mysterious in history. This is the Creek Confederation which, in the opinion of Dr. J. Walter Fewkes, director, once embraced the territory of Florida, Georgia, Mississippi, Alabama, Arkansas, Louisiana, and possibly East Texas.

Dr. Fewkes plans to follow the trail of the ill-fated Spanish explorer, De Soto, discoverer of the Mississippi. Records left by followers of De Soto who finally escaped from the deadly tangles of the southern swamps tell of a large number of palisaded towns inhabited by a tribe with a high degree of culture. There is a possibility, Dr. Fewkes believes, that most of the trail led through the territory of the confederation.

They were mound builders and sun worshippers. Some of their pottery which has been taken from the mounds indicates an artistic and cultural development higher than any other in North America previous to the coming of the white men. Little is known of the political system which bound the great confederation of allied tribes. Equally mysterious is their origin and their final fate. There is every indication that the confederation was in its last stages when it came under the observation of De Soto and his men.

The carvings left by the various tribes indicate a possible relationship with the Aztecs and some scholars of pre-Columbian history have jumped to the conclusion that they were a closely related people. Dr. Fewkes states that this is questionable. Even should it prove to be the case, it is doubtful whether they had attained the same degree of culture as their Mexican brethren who had the advantage of contact with the Mayas. There is evidence, however, that they were a superior people to the Six Nations. They were aggressive and warlike, as De Soto found to his sorrow.

Discoveries nearly every year indicate that the territory of the confederation was very extensive. Recent excavations in central Tennessee have brought to light the palisaded towns and sun palaces of either the same or a very similar people, constructed with a remarkable degree of engineering accuracy.

Dr. Fewkes plans to organize expeditions to dig at selected points along the supposed boundaries of the state in an effort to bear out his theory. He himself intends to return soon to the western coast of Florida where he will conduct further excavations. Gerard Fowkes, a special collaborator of the bureau, is now excavating near the site of Wilson Dam in northern Alabama. Other workers will be given directions in the near future. There is thus a possibility of unraveling one of the most mysterious chapters in American history.

THE ABSOLUTE ZERO

Science Service

Is 459 degrees below zero Fahrenheit the bottom of the thermometer scale? This question has been raised by recent calculations of Drs. Bennewitz and Simon, physicists in the University of Berlin. The peculiar habits of hydrogen at very low temperatures lead to the belief here that the substance may have a little energy left even when reduced to the so-called "absolute zero," which is 459 degrees below zero Fahrenheit. The remarkably low melting-point of hydrogen, 434 degrees below zero Fahrenheit, points to this conclusion. If such energy exists, there may be heat, and so the logical possibility of a still lower temperature.

Refractory gases like hydrogen and helium contract on cooling at a rate that would make them reach a volume of zero at 459 degrees below zero Fahrenheit, provided they did not liquefy on the way down. Thus the absolute zero has been thought by some to be the point where all heat energy and motion disappear. This view receives some support in the remarkable experiments of the noted low-temperature investigator, Kamarlingh Onnes, of Leyden, Holland. After prolonged efforts, Onnes has come within about one degree of the absolute zero, but seems to be close to a positive limit. However, no

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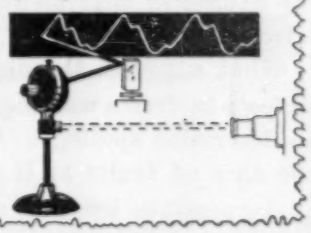

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THE USE OF X-RAYS IN FRUIT INSPECTION

Science Service

THE use of X-rays in diagnosing diseases of fruits is the latest new idea emanating from the bright end of the Dark Continent. Mr. C. W. Malley, entomologist for the Department of Agriculture of the Union of South Africa, is the originator of the idea. The department, which is anxious to increase the export trade of the country in agricultural products, could do nothing better, in his opinion, than to adopt some method whereby unsound fruit may be entirely eliminated from shipment and thus avoid financial loss to the farmers as well as the danger of enactment of severe if not prohibitive legislation on the part of foreign countries.

What suggests the use of X-rays in detecting internal defects in fruits was the common custom of candling eggs to determine spoilage. Common light can not be used in the case of fruits as it could with eggs, but X-rays can. It is possible by this scheme to detect injuries caused by the fruit-fly larvae which had matured and escaped, leaving no external signs of injury. Damage done by the codling moth, a pest that is very destructive to fruit in the United States also, can be plainly detected in pears submitted to the X-rays. Defects in oranges due to blue-mold are likewise possible of diagnosis.

Opinion as to the practicability of this method is to the effect that it is only a question of providing suitable apparatus for the farmers. At present the cost of such inspection would be prohibitive, but it should be easily possible to construct suitable X-ray apparatus for rapid handling of fruit at packing and shipping establishments.

THE BISON IN RUSSIA

Science Service

THE Soviet government has set aside 200,000 acres in the Caucasus where efforts will be made to preserve Europe's largest quadruped—the zubr, or European bison, according to word reaching here.

This creature, now almost extinct, furnishes a romantic link with the days when the continent was a great, dark forest, roamed by prehistoric tribes. He was contemporary with the mammoth and the rhinoceros. The cave men hunted him. He furnished food for the wild ancestors of present day Europeans when they first emerged from the plains of Asia. Caesar's legions encountered the creature in the woods of France and Germany, and exhibited him alive in the Roman amphitheater. He was a favorite prey of the hunting parties of the old tzars.

As in America, the bison could not live in contact with man. Gradually he was pushed back until to-day the only wild specimens are found in the forests of the Caucasus. The tzars made a few attempts to preserve the species, especially in Lithuania, where a park was set aside for them. Following the revolution it is probable that these efforts at protection went for nothing and the unfortunate creatures still further were reduced.

The Caucasus bison, close cousins of the American variety, feed on coarse, aromatic grass, and on the leaves, shoots, bark and twigs of trees.

The Soviet also is trying to preserve wild birds. Wild duck sanctuaries are to be set aside and a "crop rotation" period established in hunting—two closed years to one open.

THE DECLINE IN DIABETES

Science Service

A DECLINE in diabetes may be expected since the occurrence of this disease has now about reached its maximum, according to a report by Dr. Elliot P. Joslin, of Boston, one of the leading specialists in this disease, to the American Medical Association. Particularly is a decrease in case and death rates to be expected if proper preventive measures, involving use of insulin, proper diet or both are taken.

Dr. Joslin finds that the diabetic patient of to-day averages eleven years older than those seen ten years ago. Early fatal cases and groups of living patients in former years averaged 41 years of age, but a similar group now averages 52 years of age.

The chief predisposing cause of diabetes is fat. Diabetes has always been known to be more common among Jews than other persons, and this increased incidence is due to overweight. Eighty-five per cent. of Jewish patients were overweight in contrast to 70 per cent. of 1,000 non-Jewish patients. He finds no congenital tendency to diabetes among the Jewish patients, but rather an increased incidence of diabetes when such patients become older and fat.

Experience with insulin thus far confirms the impression that it is a great discovery. Diet alone is sufficient for a large proportion of the diabetic patients in advanced life, but insulin has been of great educational value in causing the public to give more attention to diet and to a study of the human body.

SAWDUST AS A SMOKE PEST

Science Service

NORTHWEST coast cities have developed a "smoke nuisance" of a unique type, in the frequent fires caused by spontaneous combustion in the enormous heaps of sawdust accumulated on old sawmill sites.

Following a year's rest "Vesuvius," Leshi Beach's sawdust volcano, has become active and has driven residents of the district from their homes with its clouds of heavy smoke. City firemen subdued the smudge by a generous soaking of the crater. At Port Angeles a sawdut pile has simmered and smoked for twenty years, now and then bursting forth in flame and huge black clouds of smoke.

At Everett, a pile of mill refuse covering an area of ten acres is a source of constant menace because it has been burning within for years. To remove the eyesore would require a vast amount of money and to burn it at once would be impracticable. The heap would burn and smolder for weeks making the city and near-by towns almost uninhabitable.

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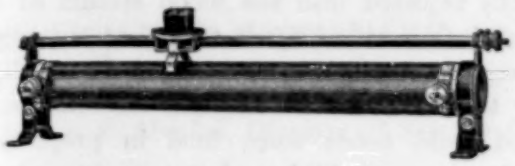

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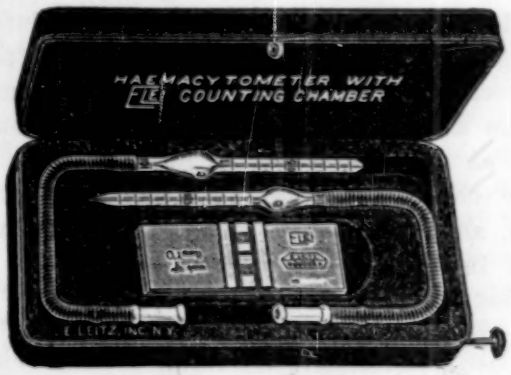

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expansion of the industrial part of Seattle, the city council is now considering a plan whereby huge hydraulic machinery can be utilized to loosen and wash away the refuse into the Elliott Bay, an arm of Puget Sound.

To date no use has been found for the old sawdust, the few factories requiring this material demanding clean fresh refuse direct from the mills.

GROWTH OF THE TIMBER CROP

Science Service

GOVERNMENT forests are more and more coming to be looked upon as timber farms and the methods of foresters are the methods of scientific farmers. They are not content merely to produce and protect their crops of trees; they want to know how well their crops are doing and by what methods they can produce the most wood in the least time. To this end present day forestry studies are directed.

From Medicine Bow National Forest in Wyoming comes the somewhat unexpected report that slowing down the growth of lodgepole pine trees while they are young seems in the end to produce better trees. Two equal plots that had been cleared of standing timber were selected for experiment. On one of them, the slash, that is, the tops and branches left after lumbering operations, was burned, leaving the ground quite clear. On the other, the slash was scattered evenly over the area. On the first plot lodgepole pine seedlings appeared early and grew rapidly, but soon suffered from crowding, and the growth became irregular and finally slowed down again. On the second plot the start was later and there were not so many young trees, due probably to the shading effect of the scattered slash, but in the end the growth was rapid and the promise of normal forest development better.

In the Bitterroot National Forest in Montana observations were made on the rates of growth in western yellow pines left standing as seed trees after an area had been logged off. They showed an average growth after cutting nearly twice as great as for the same length of time before cutting. The observations extended over a period of fifteen years, and showed that in general the greatest acceleration in growth came during the last five years of that period.

ITEMS

Science Service

SPINACH, long included as desirable on diet lists for children, has received a new boost as the result of experiments conducted by Dr. Walter H. Eddy, of Columbia University. Dr. Eddy has also shown that the vegetable loses none of its vitamin content in canning, a discovery of practical value in regions where a winter supply of vitamin-containing vegetables become very expensive if they must be purchased fresh. Dr. Eddy found that as little as one fourth of a gram of raw spinach, or its equivalent in canned spinach, is "amply protective against scurvy in a guinea pig regardless of whether the spinach is processed 70 minutes at 240 degrees Fahrenheit or 120 minutes at 240 degrees. Blanching with steam for one minute or with hot water for two minutes or for five minutes failed to affect this result."

INSULIN injected into the blood stream of an undernourished infant will help it to utilize the sugar in the food given it, Dr. W. K. Marriot, of St. Louis, reported recently to the American Medical Association. A malnourished child needs more food in proportion to its weight than normal children, but sometimes the malnourished child lacks the ability to take care of all the food it should get, so heroic methods to help it are resorted to. Glucose, the sugar of corn syrup, is injected into the veins along with a considerable amount of insulin. That the child makes good use of the food thus strangely taken in is indicated by the increase in weight. The weight gained is not later lost when the treatment is discontinued.

LEVULOSE, a valuable sugar heretofore so difficult to produce that it has cost from $30 to $110 a pound, can now be made cheaply enough to be used on anybody's table, by a process worked out in the laboratories of the U. S. Bureau of Standards. It is extracted from dahlias and from Jerusalem artichoke, the latter an exceedingly common weed of the wild sunflower family that grows abundantly in low, moist places, too wet for profitable crop cultivation. Levulose is chemically closely related to glucose, which is the sugar forming the base of most table syrups now used. The bureau has formerly been able to produce a levulose syrup, but has now succeeded also in extracting a pure crystalline sugar suitable for table use.

DR. KATE GORDON after a comparison of the intelligence quotients of the right-handed and left-handed children in a group of 1,019 children finds no confirmation of the traditional opinion that left-handed individuals are of left-handed or inferior intelligence. In fact the slight difference in intelligence found by Dr. Gordon was in favor of the left-handed. But although left-handed persons are not necessarily inferior in intelligence, it is probably true that among subnormal individuals there is a big percentage of left-handedness. Dr. Gordon finds as other investigators do that there are more left-handed boys than girls and that left-handedness runs in families.

FISH can be furnished with much relished food through the rearing of the young of certain water insects known as "bloodworms" in streams polluted with dairy wastes, Professor C. L. Walker, of Cornell University, has determined as the result of an investigation of the satisfactory disposal of wastes from dairy manufacturing and shipping plants. Thus the amount of fish life which a stream may support is increased and the injurious matter is reduced to endurable limits. He also found that sludge, valuable as a fertilizer, can be produced from otherwise useless milk and whey by chemical precipitation or in septic tanks.

CUT flowers have been freed from the quarantine ban placed upon the importation of many kinds of plant products from Canada.

THE Mexican bean beetle is spreading northward in this country at the rate of 150 miles a year.

SCIENCE NEWS

NOTES ON THE CENTENARY OF THE FRANKLIN INSTITUTE

(By Edwin E. Slosson, Director of Science Service)

Six Nobel prize men on a single program is the unique achievement of the Franklin Institute for its centenary celebration, at Philadelphia, September 17 to 19. The annual prizes of $40,000 for the greatest discoveries in chemistry and physics are awarded by the Nobel Foundation in Stockholm without distinction of nationality and these six scientists represent four countries. Sir William Bragg, of London, is the leading authority of the world on the structure of crystals and his son, Professor William L. Bragg, of Manchester, shares his father's field and fame. Their compatriot, Sir Ernest Rutherford, of Cambridge, startled the scientific world in 1903 by the theory that atoms are not immutable but that radium breaks up into other elements. Professor Pieter Zeeman, of Amsterdam, has put his name permanently into all languages as the discoverer of the "Zeeman effect," the doubling of spectral lines in a magnetic field. Professor Fritz Haber, of Berlin, is the inventor of the Haber process for converting the nitrogen of the air into ammonia and nitric acid. The only American of the group is Professor A. A. Michelson, of Chicago, and he was born in Germany. He has made the most accurate determinations of the wave lengths and velocity of light. His latest determination of this constant made this summer at Mount Wilson gives 186,330 miles per second for the velocity of light.

It will be noticed that these various researches made by independent investigators in different countries are yet coordinated and all contribute toward the solution of the greatest physical problem of the present, the structure of the atom and its relation to light. As Sir William Bragg said the last few years have given us more knowledge of atomic and molecular structure than had been gained in ten thousand years preceding. The new tool which has enabled Sir William to see how the atoms are put together in mineral or metal is the X-ray which has waves ten thousand times shorter than light and so can penetrate opaque solids and reveal the bones in the human body. The X-rays that are reflected from the interior of solids disclose their crystalline structure and the connections of their atoms. It is the annual custom of a professor of chemistry to astonish his freshmen insofar as modern freshmen can be astonished by telling them that the clear crystalline diamond and the black greasy graphite are composed of the same element, carbon. He could prove it to his class but he could not explain it if any student were so rude as to ask him. But when Sir William Bragg held up in one hand a model of the diamond molecule and in the other a model of the graphite molecule we could all see that the difference was merely one of structure. The models were made of wooden balls stuck together by wires. Any boy could make one for himself out of peas and toothpicks. Four toothpicks are to be stuck into each pea so as to be as far apart as possible and equally distant, or to put it in mathematical language so they form a regular tetrahedron. When enough of the balls are so stuck together it will be seen that the structure takes the shape of a diamond crystal, that it shows the natural cleavage planes along which the diamond is cut for jewelry, that the carbon atoms represented by the balls form zigzag chains and also hexagonal rings. Now such long carbon chains and six-membered rings are the very forms which chemists invented years ago to picture for books and blackboards the molecules of organic compounds but without supposing that they were anything more than mere symbols. In the graphite molecule the carbon atoms are laid in layers and it is the sliding of these layers over one another that makes graphite a good lubricant. It is a similar structure as the speaker said "that makes grease greasy." He has examined various fats by reflected X-rays and finds that they consist of thirty or more carbon atoms in a snaky series with an acid head containing two oxygen atoms. Now when a drop of grease is squeezed thin between two glass plates all the fat molecules arrange themselves perpendicularly in double layers half of them upright and the other half head down. One molecule layer sticks to the surface of the solid and the other slides easily over it.

In his public address in the evening Sir Ernest Rutherford analyzed the structure of the atom as Sir William Bragg had analyzed the structure of the molecule. He showed us how he has been able to smash up the atoms of many elements by bombarding them with powerful particles projected from radium atoms as these break up spontaneously. The projectiles are known as alpha particles and weigh about four times as much as an atom of hydrogen, the lightest of elements. They carry a double charge of positive electricity, but whenever they can steal two negative electrons from the atoms that they drive through in their swift flight they settle down into inert atoms of helium gas, a very different element from the heavy metal radium which gave them birth. By means of a new and more delicate apparatus Professor Rutherford has succeeded in disintegrating the atoms of many of the natural elements, namely nitrogen, aluminum, sodium, potassium, boron, phosphorus, fluorine, magnesium, silicon, sulphur, chlorine and argon. But some of the elements, notably oxygen, have so far stubbornly resisted his best efforts to break into the nucleus of their atoms. This exceptional stability may account for the fact that oxygen forms half of the substance of the rocks, air and water taken together. When the elements are arranged in the order of their atomic weights and numbered from hydrogen the lightest to uranium the heaviest it is found that the even numbered elements form eighty-six per cent. of the earth's crust as we know it. Oxygen is one of the even numbered elements and its nucleus is supposed to contain four alpha particles each made up of four hydrogen nuclei, forming a strong and stable structure.

WHO is the greatest man of science that America has produced in the last hundred years? You may have ten guesses and more if you like for you may need them. But if you asked any of the three hundred distinguished scientists assembled to celebrate the centenary of the Franklin Institute you would be apt to get the same reply—"Willard Gibbs." The genius of the quiet unassuming Yale professor of mathematics was recognized in Europe before it was in his own country and two of the overseas speakers, Professor Fritz Haber, of Berlin, and Professor F. G. Donnan, of London, have cited him as a pioneer in their fields.

Professor Donnan in his address quoted Henry Adams, the historian, in saying that, after Benjamin Franklin, Gibbs was the greatest man of science that America has produced and he added "that in the history of the physical science of the seventeenth, eighteenth and nineteenth centuries Gibbs ranks with men like Newton, Lagrange and Hamilton who, by sheer force of power of their minds, have produced those generalized statements of scientific law which mark epochs in the advance of science. So faithfully and wisely did he use the splendid gifts which nature bestowed on him that after a half century of time his work remains a potent and living force."

Professor Donnan told how during the war when it was necessary to make ammonium nitrate in enormous quantities for the British high explosive amatol the munition chemist solved the problem by the use of Gibbs's thermodynamic formula. Professor Donnan generously gave credit to Gibbs for the prior discovery of what is known as the "Donnan equilibrium formula" which the late Jacques Loeb made the basis of his theory of colloid chemistry.

Professor W. D. Bancroft, of Cornell, in his address on colloid chemistry also called Gibbs an epoch-maker in this new and fertile field. He defined colloid chemistry as "the science of bubbles, drops, grains, filaments and films," and showed its practical importance in all the industries dealing with such forms. Bubbles are employed by the makers of carbonated drinks, fluffed ice cream and floating soaps and in the flotation process of ore purification. Drops are the controlling factor in mayonnaise, margarine and milk, as well as in the formation of rain clouds. A knowledge of grains is essential in the manufacture of glass, pottery, brick, cement, starch, crayons and photography. Filaments include all the textiles, rubber, asbestos, coke and soap. The science of films covers paints, varnishes, glue, printing, filters, lubrication and oiled roads. The bare list shows what a large part the colloid chemist must play in our daily life.

One of the most difficult and dangerous branches of colloid chemistry is that which deals with the manufacture of high explosives as Dr. Charles L. Reese, of Wilmington, explained. By dissolving the solid nitrocellulose in the liquid nitroglycerine a colloid called blasting gelatin is obtained that is safer than the latter and stronger than the former ingredient. In the search for new and better explosives during the war and after a large number of raw materials were nitrated. Among them were starch, sugar and lactic acid. Glycerine was formerly extracted from fats but can now be formed by the fermentation of molasses. So it seems that our most innocuous and nutritious foods, such as milk and molasses, sugar and starch, may be made into explosive material to destroy our enemies or exploit our mines. For the peace time employment of high explosives amounts in the long run to more than the war time. Last year the production of explosives in the United States amounted to five hundred and thirty million pounds and this involved the preparation of a hundred million pounds of nitroglycerine. At the conclusion of the war the government had left on its hands nearly four hundred million pounds of explosive material and it proposed to throw it into the ocean to get rid of it. But much of the picric acid and TNT has since been used by the government in road building and distribution to the farmers and the smokeless powder is being reground under water to make dynamite for such purposes as ditch digging and stump blasting.

Power in more continuous form has been discussed at the sessions by two men responsible for the two most modern methods of generating power from fuel. The famous English engineer who fathered the steam turbine, Sir Charles Algernon Parsons, predicted a bright future for this type of engine which has become dominant on sea and land because of its high efficiency and the simplicity of its rotary motion. Sir Charles told of the continual progress toward higher pressures resulting in greater economy of coal. High speed turbines operating at 1,500 pounds per square inch are now under construction whereas the usual steam plant operates at 200 pounds steam.

Mercury is the life blood of a new kind of power producer described by William LeRoy Emmet, consulting engineer of the General Electric Company, inventor of the mercury boiler. A half million dollars has already been spent in perfecting this invention and by vaporizing mercury instead of water a gain in efficiency of nearly 50 per cent. is obtained since mercury boils at a temperature some three times that of water and can utilize the heat from the fuel more effectively. Already an initial installation has been so successful that a large mercury boiler and turbine unit is being made to supply electricity for Hartford, Conn. Like the steam turbine, the mercury boiler is going to sea and Mr. Emmet expects his invention to make marine transportation cheaper.

THE appearance of a German scientist among the honored guests and leading speakers at the hundredth anniversary of the founding of the Franklin Institute may be considered an indication that the war is over and that the internationalism of science may again be restored. Certainly the institute in extending such an invitation to a representative of the German Chemical Society was acting in the spirit of its patriotic patron saint who held that "there never was a good war or a bad peace" and who negotiated the treaty with Prussia which held till 1917.

No man contributed more to the military power and endurance of Germany than her delegate to the centenary, Professor F. Haber, director of the Institute for Physical

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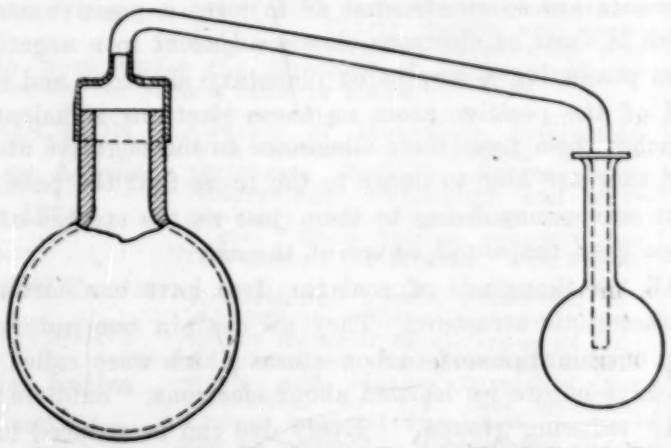

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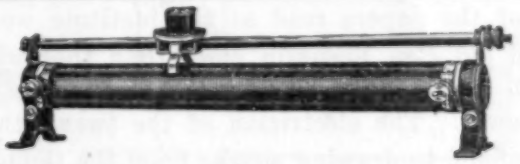

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Chemistry and Electrochemistry at Berlin, for it was the Haber process for the fixation of atmospheric nitrogen that supplied that country with high explosives and fertilizers when cut off from Chilean nitrates.

In his address he showed how such practical applications of chemistry followed the development of fundamental scientific theories each of which opens a new epoch. In the first period chemists were absorbed in the study of the structure of molecules and how the atoms were connected. In the second period chemistry became dynamic and ideas of energy took the place of the static conceptions previously prevailing. The third period we are now entering when the chemist has to consider particles smaller than atoms, the electrons, and has come to deal with atoms of energy, the quanta. The chemist can now enter the domain of life since he is learning the laws of cell membranes and the colloid contents which form the substance of living beings. Man begins by imitating nature but may learn to surpass her in food products as he has already done in the manufacture of dyes and drugs and the fixation of nitrogen.

Dr. Haber then dipped into the future and prophesied that "now we may expect the exploration of those paths by which nature brings forth her living things. The most urgent chemical need is providing for our sustenance and our health. Nutrition and cure are the tasks of natural science opening new fields to industry and new prospects of a happier state of man. We are far enough advanced in science to know the minute difference between the structure of starch and cellulose. But we are not yet far enough advanced to be able to live in stalks of corn instead of the grain of wheat."

None of the papers read at the institute would have interested old Ben Franklin more than that which told about his lightning rod and how to improve its protective power. The electrician of the twentieth century is not confined to drawing sparks from the thunderclouds by means of a kite and a key. He sets up and charges a thunder cloud of his own and produces lightning to order in his laboratory. F. W. Peek, Jr., of the General Electric Company, described his artificial lightning plant at Pittsfield, Mass., that supplies a charge of two million volts at a rate equal to several million horsepower. In the path of such a discharge wood is blown to pieces and wires are converted into vapor. Besides such laboratory experiments a field party has been studying natural lightning as it runs wild in the mountains of Colorado. It is found that lightning has a voltage of about a hundred million which is a million times more than the ordinary household lighting circuit. The most striking characteristic of lightning is its proverbial quickness. A current of eighty thousand amperes may pass from the cloud to the ground in a few millionths of a second. On its way through the air it performs all sorts of pranks, knocking off electrons from atoms as a wind blows off hats in a street. The atoms thus deprived of their natural companions hook up with any other atoms that are handy. So it happens after a thunderstorm that some oxygen atoms instead of pairing off in their usual way get connected in a triple group called by the chemist "ozone" and by the ignorant "a sulphurous smell." Sometimes the oxygen connects with nitrogen and then the soil is enriched with nitric acid as good as any Haber could make though not so cheap. We may even assume that the nitrogen atoms that get hit the hardest may be smashed quite to pieces and that other elements, helium or hydrogen, may be formed from the fragments.

THE secret of the cause of color and why dyes dye is to be found, according to Professor Julius Stieglitz, of the University of Chicago, in the dance of two tethered electrons attached to a carbon atom. This original theory was explained and illustrated in one of the sectional sessions of the Franklin Institute Centenary. The table of the lecture room was set with a series of wine glasses such as might serve for a pre-war banquet but which turned out to be intended for purely chemical purposes. In one of them Professor Stieglitz dissolved a white powder and by adding to the solution liquids equally colorless the contents of the glass changed successively to yellow, to red, to brown and to black while the lantern projected on the screen the carbon chains and rings of the structural symbols of the dyes produced. What he was doing, it appeared, was loosening up a pair of electrons belonging to one of the carbon atoms so they could vibrate in tune with the light waves received by the substance. The little waves at the violet end of the rainbow spectrum were easiest to absorb and the light that was left to be perceived by the eye belonged to the red and yellow end of the spectrum. By giving the electrons a little greater freedom of movement they were able finally to respond to all the wavelengths and so to absorb all the light leaving the liquid black and opaque. For the color that we attribute to an object is not the color that it catches out of the light and holds but the color that it rejects and returns to our eyes.

Now, according to the Stieglitz theory, all dyes and pigments are so constructed as to have a positive atom which is short of electrons closely adjacent to a negative atom possessing a surplus of planetary electrons and the pull of the positive atom on these electrons sufficiently detaches them from their allegiance to the negative atom that they are able to dance to the tunes that the passing light waves may bring to them just as the strings of a piano echo the sound waves of the air.

All the thousands of coal tar dyes have one common characteristic structure. They all contain two antagonistic combinations of carbon atoms which were called in the days before we learned about electrons, "oxidizing" and "reducing groups." Every dye can be reduced to a colorless form, a white powder, by reduction, which as we now know consists in adding electrons to certain carbon atoms that needed them. The effort to get back lost electrons is what the early chemists called the "elective affinity" of the elements until Goethe gave the term a bad reputation by applying it to human affairs. If Goethe were living to-day he might carry his analogy farther for it seems that a period of increasing agitation and excitation of the electrons precedes the union or separation of two atoms, and this is what gives color to the world.

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SCIENCE NEWS

THE BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH

Science Service

WHEN the population of the United States reaches 200,000,000, as some authorities claim it will in less than one hundred years, the problem of obtaining sufficient food is going to be severe. Far-sighted scientists are endeavoring to anticipate this, and to answer the question before it becomes acute. The Boyce Thompson Institute for Plant Research, Yonkers, N. Y., formally opened on September 24, is an embodiment of this effort.

Human beings, in a savage state, are opportunists. They get their food as chance offers and do without when they must, but civilized man of the twentieth century is beginning to realize that the serious problem of food for the coming generations must be solved in advance and by more scientific methods. The cheap, rich, easily accessible lands of the last century are pretty well occupied now, and the bread for our doubled population of to-morrow will have to come from crops that have been taught to be doubly productive.

Realization of the seriousness of the basic food problem, and appreciation of the steps necessary for its solution, underlie the establishment of the Boyce Thompson Institute. It is the materialization of a dream of an engineer-scientist, and it may become the cradle of a technology as yet unborn.

During the last century great research foundations were established for inquiry into the basic facts of chemistry, electricity, hydraulics and other non-biological sciences, and in them were bred astonishing advances in material civilization of the past half-century. They made the atmosphere, colored the light, in which Colonel William Boyce Thompson, mining engineer, the founder of the institute, was reared. His nickname, "Colonel Facts Thompson," indicates the trend of the past few decades which have changed engineering from a largely empiric art to an exact science, founded on things known and not guessed at.

It was not remarkable then that when Colonel Thompson looked at the looming problem of food for the future, he should think in terms of basic research for facts on which a technology could later be established. The remarkable development of the past few decades in agriculture, forestry and other applied branches of botanical science has been founded on surprisingly little exactly known fact. Present achievement in applied biology shines only by comparison with the dense darkness that preceded it; it is nothing compared with the progress that may be made possible by the acquisition of new basic facts about plants, and the further refinement of basic facts already partly known.

The attack on plant problems in the Boyce Thompson Institute will be fundamentally the same as that on the problems of inorganic matter in the earlier researches. Chemists and physicists get at the basic facts about iron and clay and electricity by studying their behavior under exactly controlled conditions. Botanists and physiologists will get at the basic facts about plants by controlling their environmental conditions. The elaborate machinery for controlling the circumstances of the lives of plants at the institute reflects at once the analytical mind of the botanist and the ingenuity of the engineer.

Plants respond to changes in temperature; therefore automatic devices control the temperature in the rooms and greenhouses within one degree. Plants behave differently under different intensities and colors of light, and with differing lengths of day; therefore color screens and great batteries of thousand-watt lamps enable experimenters to supplement, modify and even replace the light of the sun. Plants must have carbon dioxide from the air; therefore generators make it possible to supply this gas in any concentration desired, or to withhold it altogether.

So it is with other environmental factors. Every influence in plant life has its set of controls. The plants at the institute will live in a little universe regulated by science instead of nature.

The Boyce Thompson Institute itself is the result of an interaction of several minds. The chief advisers to Colonel Thompson are Professor John M. Coulter, head of the botany department at the University of Chicago; Professor L. R. Jones, head of the department of plant pathology at the University of Wisconsin, and Dr. Raymond F. Bacon, formerly director of the Mellon Institute of Industrial Research. The active head of the institute and director of research is Dr. William Crocker, formerly in charge of plant physiology at the University of Chicago.

THE INTERNATIONAL CONGRESS OF AMERICANISTS

Science Service

SOME one else beat Columbus twenty years in the discovery of the American mainland. Tobacco was not a native product of the American Indians, but had come to them from Africa. These are only two of the startling theories that were advanced and defended at the twenty-first world congress of Americanists, which has just been held in Gothenburg, Sweden. An "Americanist" is an expert on any phase of the ancient and primitive civilization in the western hemisphere. There were one hundred and fifty of them assembled from all parts of the world at Gothenburg, and eighty papers in all were presented at the sessions.

Dr. Sophus Larsen, of Copenhagen, was the one who offered evidence that a Portuguese admiral, Joao Vaz Corte-Real, commanded by his king to discover new lands, had in 1474 reached the shores near the mouth of the St. Lawrence River. This region was afterwards called "Stockfishland," and, according to a history of the Azores, Joao Vaz was made viceroy over part of these islands in 1474 as a reward for his discovery. Charts

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published as early as 1534, says Dr. Larsen, show the names Joao Vaz Bay and Joao Vaz Land in the Labrador region.

Another lecturer, Professor Leo Wiener, of Harvard University, presented a theory at Gothenburg which conflicts with the history we learned in our school days. He declared that tobacco was well known in Europe before the discovery of America, and that America herself had got it from Africa. His theory is based on language researches in which he had been able to trace back the use of the word "tobacco," in various spellings, and in many countries, to times long before the voyages of Columbus.

Professor Franz Boas, of Columbia University, declared that ancient civilization in America, dating back some 10,000 years, had developed independently of other countries. He believed that the people themselves had originated in the old world and migrated to the Western Hemisphere but that their civilization was peculiar to America. Thus their agriculture was based on the growing of maize (Indian corn) which was native in Mexico. The making of pottery also developed without influence from abroad. The use of bronze for weapons, tools, etc., came at a very late period in America, and in the earliest stages copper in natural state was hammered out into the various shapes needed. Here again, Professor Boas saw no influence from abroad. He pointed out further that vehicles with wheels were unknown in America, and that neither horses nor cattle were used to assist man in tilling the soil. The professor concluded from these, and many other evidences, that ancient American culture was of spontaneous development.

Several experts on the Maya civilization, which flourished in Central America hundreds of years before Columbus reached the West Indies, presented papers of unusual interest, in many cases illustrated with stereopticon views. Thus Professor Sylvanus G. Morley, of the Carnegie Institution, came to Gothenburg fresh from his excavations of the ancient Maya city Chichen Itza in Yucatan. He told of having found remarkable ruins in this, the sacred city of the Mayas, temples with hundreds of stately columns, beautiful graven images of gods, bas-relief sculpture and pictorial designs which prove a high artistic development. Professor Morley drew a smile from his fellow-citizens by announcing that he had also uncovered a well-preserved ball field for public games.

Dr. Joseph Spinden, of Harvard University, reported on the surprisingly accurate astronomical calculations of the Maya scientists, and declared that it was possible to date back some of their "stone calendars" to the year 3373 B. C. William Gates, president of the American Maya Society, who has classified about 2,000 hieroglyphic characters, and has spent a quarter of a century in trying to discover their meaning, expressed his belief that the key to these Maya writings will soon be found, and that future research would reveal a civilization in Central America fully as fascinating as that of ancient Egypt.

THE APPLICATIONS OF ELECTRICITY

Science Service

ELECTRICITY from Franklin's kite to modern radio—the long list of far-reaching discoveries, prophecies overleaped, and revolutionary applications in the promotion of human welfare were discussed in rapid review by Dr. E. W. Rice, Jr., honorary chairman of the board of directors of the General Electric Company, before the centenary celebration of the Franklin Institute at Philadelphia.

Dr. Rice reminded his hearers that in its very infancy electrical research was recognized and rewarded, when the Royal Society elected Benjamin Franklin to membership. Franklin was the first American ever to be thus honored.

The foundations of modern electrical industry, Dr. Rice stated, were laid many years ago in two discoveries, that of the electric arc by Davy and the phenomenon of electro-magnetic induction by Faraday. From these beginnings the development of the applications of electricity has gone on at such a speed as to keep research workers always on a keen edge to meet the demands of the industry.

As an example, the speaker cited a prophecy made in 1900 that carbon would always be used for the electrode in the arc lamp, for the filament in the incandescent lamp and for a brush in direct current dynamos. In less than ten years it was displaced, wholly in the incandescent lamp and partly in the other two uses.

The progress in electro-chemistry, according to Dr. Rice, has been one of the most outstanding achievements in the electrical field. The early achievements in the making of aluminum, carborundum and calcium carbide have been followed by a host of new discoveries. In electro-physics results have been equally noteworthy, the discovery of X-rays and Becquerel rays leading to the researches that gave radium to the world. Research in electricity fathered modern communication, beginning with the telephone and continuing to the radio.

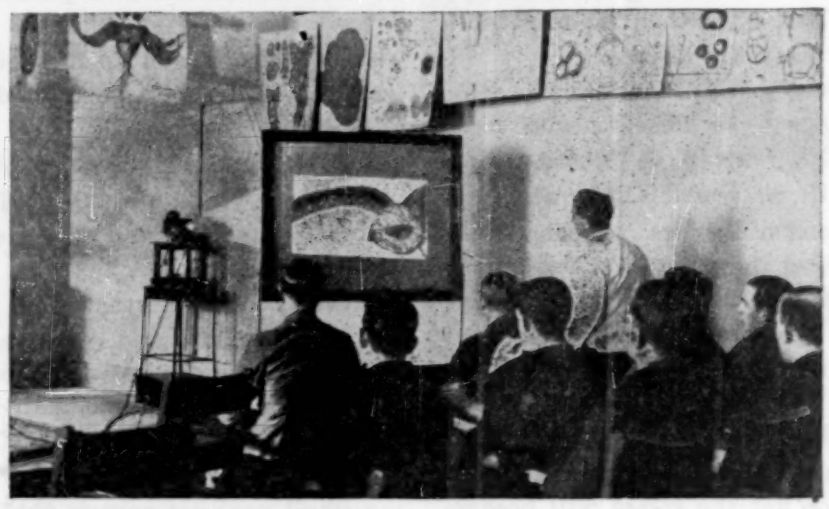
Dr. Rice listed a number of fields that give promise of further fruit when explored by researchers in electricity; among them are vacuum tubes, X-ray tubes, kenetrons, X-ray spectrum analysis, and many others, some of which have hardly even been touched as yet.

THE NEW COMET

Science Service

A COMET, which may never have been observed before, has been discovered at the Bonn, Germany, Observatory, by Professor Finsler. It is brighter than any comet that has appeared for several years, and the reports received by the Harvard College Observatory, Cambridge, Mass., from the International Astronomical Bureau at Copenhagen, state that it is visible through strong field glasses, binoculars and small telescopes. Its astronomical magnitude is eight. This visitor to the solar system is sufficiently well developed to show a faint tail, and is moving southeast at considerable speed in the western sky shortly after sunset.

The discovery was made on September 15, when a doubtful observation gave a right ascension of thirteen hours and thirteen minutes and a declination of plus nineteen degrees. A second position was secured at the Bonn Observatory two days later and the results were then sent to the observatory at Kiel, which transmitted them to the International Bureau, which distributes to



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observatories information about new astronomical discoveries. Professor Prager, of Babelsberg Observatory, about nine miles outside of Hamburg, then reported that he also had located the new heavenly object.

American astronomers were notified of the German observations at once. At least two observatories have located the comet. Lick Observatory at Mount Hamilton, California, and the U. S. Naval Observatory at Washington, have both determined its position, and astronomers are now computing its orbit. On September 23, it was located 14 degrees south and 2 degrees east of the star Arcturus, and was found to be moving at the rate of a little over a degree a day both south and east.

There is a possibility that this comet will become visible to the naked eye and become an object which all may observe. Whether or not the comet will become brighter than at present will not be known definitely until it is determined just what path the visitor is traveling. Such information will have to await the computation of the comet's orbit and this is a matter of several days' work after at least three observations of greater precision than those obtained so far are reported.

COMETS, GREAT AND SMALL

Science Service

FOR more than twenty years astronomers have been anticipating the arrival of a great comet, worthy successor of the great comets of 1811, 1843, Donati's famous comet of 1858 and the great comets of 1880 and 1882, but so far they have looked in vain, for great comets, like great geniuses, are rare. Yet the present century has not been without its noteworthy and remarkable comets.

Chief among these were Halley's periodic comet, which returns every seventy-five years and which made its predicted return strictly on time in 1910, and the comet known as a1910 which was discovered in the southern hemisphere in the same year and which rivaled Halley's comet in brilliancy. Then there have been comets which were scarcely visible to the naked eye, but which were of great interest telescopically, such as Morehouse's comet of 1908 and Delavan's comet of 1913. Indeed the freakish and erratic beh vior of Morehouse's comet surpassed that of any other known comet, and its antics were observed with the keenest interest by the astronomical world because of the light that they might throw on the nature of comets in general.

Periodic comets, such as Encke's comet which has the shortest period of any known comet, three and a third years, and which was picked up this year at the Yerkes Observatory on July 31 by Professor G. Van Biesbroeck, and Faye's and Tempel's comets, due this fall, are continually returning to the vicinity of the sun. Scarcely a year passes that several such comets are not picked up. Most of these periodic comets, however, are small, inconspicuous telescopic objects, often tailless, mere fuzzy patches, which are members of Jupiter's family of comets. For the huge planet plays the part of the spider to many a luckless comet fly spreading out his gravitational web to catch any comet that chances to come within its reach. The captured comet subdued and harnessed is then forced to follow a path that extends little if any beyond the orbit of Jupiter. Frequent returns to the vicinity of the sun tend to disintegrate a comet and scatter its substance along its orbit in the form of clouds of meteoric particles.

The nucleus and head of a comet consists of a mass of meteoric particles of various sizes held together by their mutual attraction and surrounded by rare vapors and gaseous compounds; cyanogen, hydrogen and iron vapors frequently being present. As the comet draws near the sun light-pressure and electrical repulsion drive off from the head finely divided particles that go to form the tail. Such particles are permanently lost to the comet. They leave the head of the comet with accelerated motion and one tail is in turn discarded for another. So it is that the small periodic comets that have made many returns to the sun have little substance left to form the tails that are so characteristic of comets and look spent and faded compared to the great comets that frequently sport tails many million miles long and heads many thousand miles in diameter.

Comets great and small represent the fragments of the primitive mass from which the solar system was formed many million years ago. The great comets come fresh and unspent from the outlying regions of the solar system at intervals of thousands or even hundreds of thousands of years so it is little wonder that they shine at rare intervals with a splendor unknown to the small fry of the cometary world, Jupiter's captured family of periodic comets of which one or more members return to the sun practically every year.—*Isabel M. Lewis.*

ITEMS

Science Service

A WINDOW on the south side of a building will get in the course of a year 45 times the amount of sunlight that a window on the north side will get, according to experiments conducted by William Kunerth, associate professor of physics at Iowa State College. Mr. Kunerth's experiment does not include daylight, only sunlight. While the north window is getting one unit of sunshine to 45 for the south window, the east window gets 27 units and the southeast window gets 38 units. When the sunshine strikes a window glass at too sharp an angle the sunshine is reflected and hence does not penetrate into the room.

BEET seeds retain their germinating power for 17 years, according to experiments recently conducted by Professor K. Dorph-Petersen, of the Danish Seed Testing Station. A considerable amount of this stock was stored away seventeen years ago and some withdrawn for experiments every year. The tests showed 85 per cent. of germination the second year and 24 per cent. the seventeenth year of dormancy. Seeds of white clover germinated after twenty-five years. Only a few grass species tested showed much life after seven or eight years. Various environmental conditions may influence the length of time a seed may remain alive, Professor Dorph-Petersen believes.

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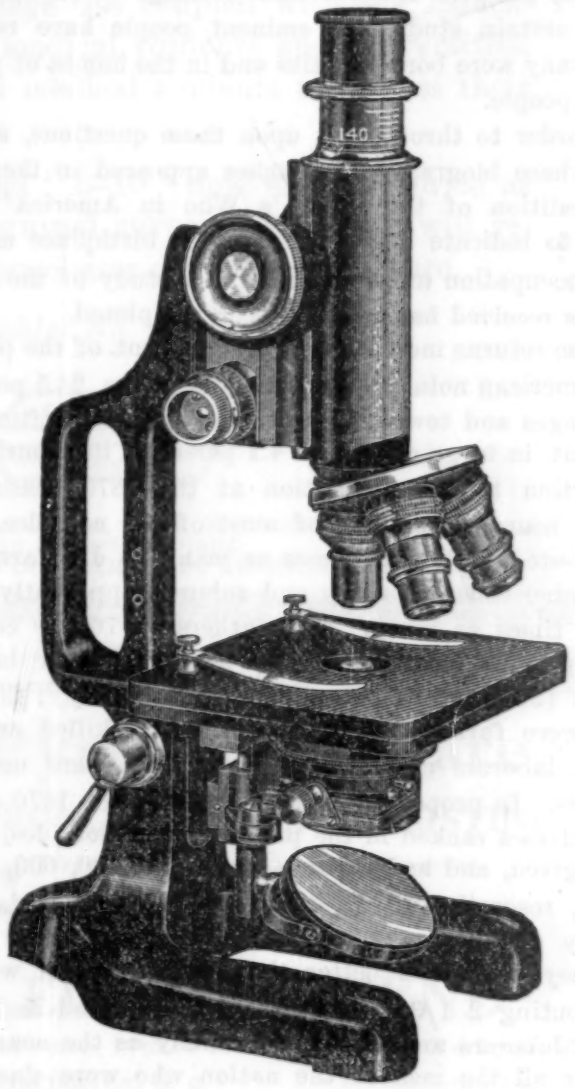

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SCIENCE NEWS

THE BIRTHPLACES OF EMINENT AMERICANS

Science Service

WHERE have the notable people been born and in what kinds of homes? This question has been asked by many, and diverse answers have been given. Some persons have asserted that most famous Americans were born on a farm, as were Lincoln and Coolidge. On the other hand, certain studies of eminent people have revealed that many were born in cities and in the homes of professional people.

In order to throw light upon these questions, all persons whose biographical sketches appeared in the 1922–1923 edition of the "Who's Who in America" were asked to indicate both their type of birthplace and the chief occupation of their father. A study of the 18,400 returns received has recently been completed.

These returns indicate that 25.9 per cent. of the present-day American notables were born on farms, 24.5 per cent. in villages and towns, 24.8 per cent. in small cities, 20.6 per cent. in large cities and 4.1 per cent. in suburbs. In proportion to the population at the 1870 census, the census nearest the birth of most of the notables, cities contributed nearly six times as many as did farms, villages nine times as many and suburbs apparently about eleven times as many. The fathers of 70 per cent. of these persons belonged to the professional or business classes (34.3 and 35.3 per cent., respectively); 23.4 per cent. were farmers, 6.3 per cent. were skilled or semi-skilled laborers and only 0.4 per cent. were unskilled laborers. In proportion to population at the 1870 census, these classes ranked in the production of notables, in the order given, and had a value of about 1,400, 600, 70, 30 and 1, respectively. In other words, farmers fathered slightly fewer notables than their proportionate share, but they did much better than other manual workers, contributing 2 1/3 times as many as skilled and semi-skilled laborers and 70 times as many as the nearly one half or all the men of the nation who were classed as unskilled laborers. Business and professional men fathered 7 and 16 times, respectively, the number of notables that would be expected on the basis of the small proportion they made of the population. Clergymen did exceptionally well, according to these returns, having fathered fully 28 times their proportional share of notables, or over 2,400 times as many as the average unskilled laborer.

There are two radically different possible interpretations of these data. Certain eminent biologists believe that heredity is of prime importance and hence that the nation's notable men come from the intellectually superior elements of the population, which are concentrated in certain types of occupations and places. On the other hand, others believe that environment is the chief factor, and, if given a proper chance, many people who never become eminent could rise so far above the average as to merit inclusion in such a standard work as "Who's Who in America."

This study does not indicate whether "nature" (environment) or "nurture" (heredity) is the more important, nor does it accurately describe conditions to-day when the leaders of the fifty years hence are being born. It does, however, clearly indicate that a large share of the present notables came from certain relatively minor elements of the population, more than 1/3 from the professional classes which comprised only 1/45 of the population in 1870. The five per cent. of the men of America classed as business men contributed 35 per cent. In contrast, unskilled laborers fathered almost none of the notables in "Who's Who," and although farmers fathered nearly one fourth, that proportion is slightly less than their share in proportion to population.—*S. S. Visher.*

A NEW GOOSEBERRY

Science Service

THE elevation of the humble gooseberry from its present position as a minor fruit, good only for pies and preserves, to the dignity of a table fruit on a par with cherries, plums and grapes, is one of the possible results from the discovery of a new species in the woods of northern Florida, a region where gooseberries have never before been known.

Gooseberries are not properly appreciated in this country is the opinion of Dr. Frederick V. Coville, botanist in charge of the Office of Economic and Systematic Botany, Bureau of Plant Industry, whose description gives the new species to science. Abroad, the fine European varieties are eaten ripe, as table fruit. But these choice varieties are subject to disease in this country, and all the hardy native species known until the present time have berries too small and poorly flavored to be of much value. Moreover, gooseberries as well as currants harbor one phase of the deadly blister rust disease that is threatening our forests of white pine, so that government forest officials are urging that gooseberry culture be strongly curtailed.

Into this rather unpromising setting the new Florida species comes almost like a horticultural fairy godmother. It is probably the biggest wild gooseberry ever discovered, the fruits reaching seven eighths of an inch in diameter. A hybrid with the large-fruited European varieties need not lose size. It is native in northern Florida, far south of the present centers of gooseberry culture, and what is even more important, far south of the white pine region. Therefore it can be cultivated without regard to the white pine blister rust, and there will be the added advantage of having berries ready for market much earlier than at present. It seems to be quite immune to the mildew disease to which the European varieties are susceptible.

In its present wild state the fruit has one notable drawback. Each berry is covered with so many long, sharp

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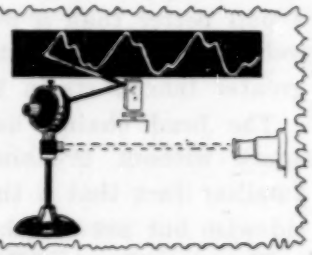

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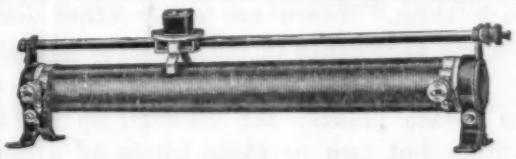

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spines that it suggests a little porcupine. It is hoped that these can be eliminated in the breeding experiments now under way at the Department of Agriculture.

The honor of the discovery of this promising berry is divided between Professor Herman Kurz, of the Florida State College for Women, and Dr. Roland M. Harper, of the Florida State Geological Survey. They came upon it in the woods along the shore of a little lake near Tallahassee in the course of a Sunday botanizing trip. They notified Dr. Coville, as the recognized expert in this part of the botanical field, and after several trips to the region to obtain specimens, seeds and bushes for transplanting, he announced the find to the scientific public.

THE CONTROL OF THE COTTON WEEVIL

Science Service

FIND what it is in the cotton plant that the boll weevil likes; produce it in marketable quantities; bait traps with it or mix it with poison, and so lure the insects to their destruction. That is the skeleton of the idea on which scientists of the U. S. Department of Agriculture are working.

When the weevil comes out of its winter sleep, in the vicinity of a cotton-field, it somehow knows enough to make a bee-line for its natural home. It will sometimes travel considerable distances to reach growing cotton if there are no plants near at hand.

Dr. Frederick B. Power, the leading biochemist in the Bureau of Chemistry, with the cooperation of V. K. Chesnut, of the same bureau, is endeavoring to find which of the many complex substances in the cotton plant gives it this peculiar attraction for the weevil and this is a very difficult task. Large quantities of cotton plants have been subjected to steam and distillation processes, and the substances isolated tested for their power of attracting boll weevils. This part of the work falls to the Bureau of Entomology, where workers watch the behavior of the insects toward the various substances.

Dr. Power states, with the characteristic caution of a thorough scientist, that he is "making progress," but will not make a direct claim that the problem has been solved. The results of the investigation will be announced to the scientific world and to the public in due time.

This new attack on the boll-weevil problem may well become the pioneer work in a wholly new departure in the study of the relations between plants and the enemies that attack them. There are many other insects that show a similar preference in the choice of the plants they feed on. Potato beetles, for instance, confine their diet chiefly to potato plants; the Hessian fly commonly attacks nothing but two or three kinds of grain. In all such cases, there must be some definite attraction exerted by the plant, some specific substance that appeals to the insect so strongly that it will turn from all other things to seek it. If such substances can be isolated and used as baits loaded with poison, or placed in insect traps, or set over pans of water or oil, or in other ways utilized to lure insect pests to their doom, another step will have been taken in the solution of the crop pest problem.

CELLULOSE

Science Service

CELLULOSE, whose chemical structure has baffled chemists for a century, is yielding to the searching eye of the X-ray spectrograph in the hands of Dr. O. L. Sponsler, botanist in the University of California, Southern Branch. The most recent photographs lead to the belief here that cellulose—a stick of wood for example—consists of a multitude of strings of molecular beads all running parallel.

Many years ago chemists discovered that cellulose consists of carbon, hydrogen and oxygen in the proportion of six, ten and five atoms, respectively. Little more is known of its chemical architecture. Cellulose does not crystallize, vaporize, melt or do any other orthodox act which would help out the analytical chemist. In the light of X-rays, however, it now yields a series of remarkable line photographs which indicate the bead-string style of structure.

The "beads" are all alike. Each apparently consists of a cluster of the twenty-one atoms above mentioned firmly combined like an individual chemical molecule, but still chemically tied to its two neighbors in the string, above and below. It requires about fifty million of these, end to end, to span the distance of one inch. Ordinary light waves are too coarse to reveal such minute details, so that there is no hope of visibility even in a powerful microscope. The minute X-rays, however, are able to pick out and exhibit such atomic details to the camera.

Dr. Sponsler pictures the cellulose units acting as beads closely strung on a tight cord. The chain resists a pull better than a push. This agrees nicely with the well-known principle that a timber will withstand a greater tensile strain than a crushing strain.

The bead chains, being separate, can easily spread apart without breaking. This also agrees with the familiar fact that a timber, soaked in water, will swell sidewise but not lengthwise.

The new theory tells us that a broken strand of cellulose should have reactive atoms at the ends of the chains, where the rupture occurred, and where there is obviously no material to hang on to the last link. This agrees with the known fact that certain chemical tests work on the end of a fiber, but do not succeed on the side.

When the cellulose fibers are photographed endwise, only a few simple lines appear on the plate, and the bead-chain structure is missed. Viewed from the side, however, the strings are revealed.

CLIMBING FISH

Science Service

THE climbing perch by no means is a figment of the imagination, according to Albert W. C. T. Herre, chief of the Philippine Division of Fisheries, who has just completed a classification of the fresh water fish of the Islands.

This fish occurs in ponds, brooks and rivers throughout the territory. Not only does it climb trees but is

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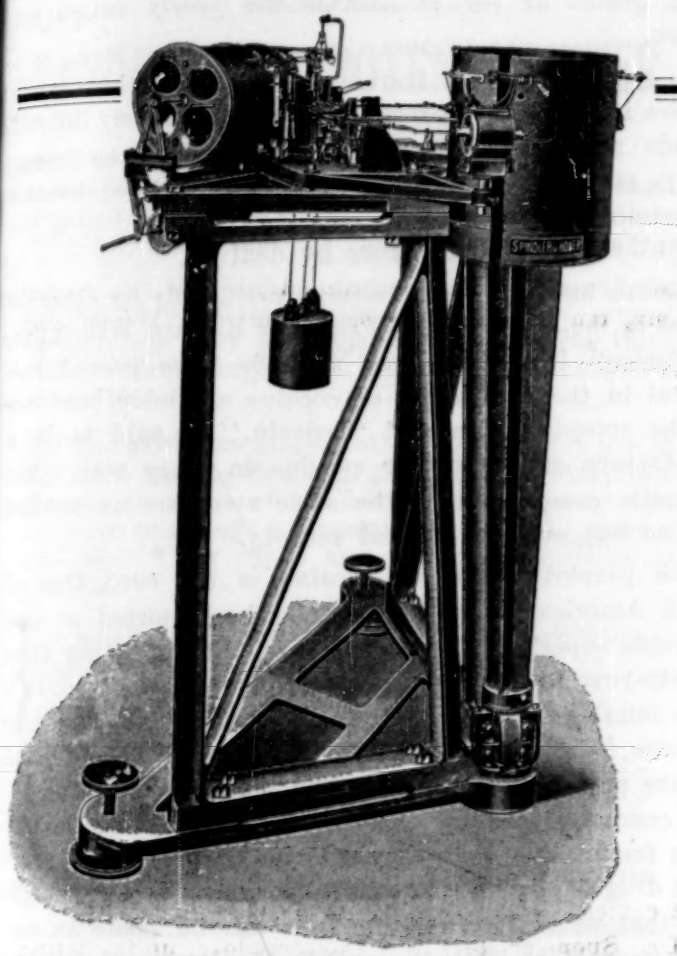

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able to move about freely on land and is remarkable for its ability to live for long periods out of the water. Its actual climbing, however, is restricted to short distances —not more than two meters up the rough trunks of certain palms.

During the dry season the climbing perch is able to survive in very small pools of semi-liquid mud. During this time it takes the hook readily. Consequently it is not unusual to see a native fishing in what seems to be a dry field of waving grain. Out of a small mud patch in such a field from one to two dozen of these fish can be taken. It is claimed that the fish can survive for six days entirely out of water.

Mr. Herre describes another order of Philippine freshwater fishes which can be drowned in water. These are the labyrinthici, characterized especially by a large cavity in the head above the gills. Into this cavity the fish takes air directly from the surface of the water. The gills are unable to supply a sufficient quantity. If prevented from reaching the surface the fish eventually will die. Popular superstitition credits these creatures with the ability to live out of water, although Mr. Herre insists that if their gills become entirely dry they will die, just as other fishes. Another species, the ophicephalidae, will drown if kept in water in such a position that they can not reach the surface occasionally. These also endure prolonged removal from water.

The most popular of Philippine food fishes, the dalag, makes long voluntary journeys over land during periods of heavy rains. When the water of an inland puddle has evaporated the dalag is able to survive for a long time by burrowing a foot or more below the surface to take advantage of the remaining moisture. Even after the surface of the mud has been caked over the fish will live as long as it is moist beneath. These fishes are sold alive in the native markets, being stunned with a club so that the customer can carry them easily.

THE USE OF OPIUM AND COCAINE

Science Service

OPIUM and cocaine, aside from the large but unknown illicit consumption, have a recognized and legal medical use to the extent of 6.98 grains of pure opium and 29.32 grains of coca leaves *per capita* per year. These figures are based on the investigation of A. G. DuMez, pharmacologist in the service of the U. S. Public Health Service.

Mr. DuMez got his figures not from a general survey of the country as a whole, but from a close study of a good "sample" of the population. He chose Allegany County, in Maryland, partly because it contained no large cities with their abnormal conditions, and partly because it was a region of diversified population following several industries. He investigated the permitted use and traffic in drugs in pharmacies, doctors' offices and hospitals.

All drugs containing opium, such as codeine, morphine and paregoric, he reduced to terms of pure opium. Similarly, he reduced cocaine to terms of the coca leaves, the form in which it is imported. He found that the legitimate medicinal needs of the county called for an annual importation of 69.81 pounds of opium and 293.03 pounds of coca leaves. Divided among the 69,938 persons in the county, this allowed 6.98 grains of opium and 29.32 grains of coca leaves as the yearly ration per person.

To supply the entire United States on this basis would require the annual importation of approximately 105,687 pounds of opium and 443,988 pounds of coca leaves. Mr. DuMez is of the opinion that the lawful requirement for cocaine is falling off, because of the increasing use of synthetic local anesthetics by dentists.

Cocaine has been manufactured artificially by chemical means in the laboratory of Professor Richard Willstätter, at Berlin. Three different methods have proved successful in the production of cocaine alkaloids, and one of the compounds, named "psicain," is said to be a satisfactory substitute for cocaine in every way. The synthetic compound has the same structure as natural cocaine but opposite optical activity.

The present source of cocaine is the coca tree of South America, whose leaves must be imported at considerable expense. The present discovery, resulting from a sixty-year search for a synthetic cocaine, may make a more reliable drug available to the medical profession at a lower price. Cocaine is worth about $100 a pound, but the primary materials used in the preparation of the new compound are not expensive. The synthetic substitutes for cocaine, such as novocaine or procaine, do not form drug habits like the natural cocaine. But if cocaine like that obtained from the leaf can be made in any laboratory it is likely to nullify the laws and treaties against its importation.

ITEMS

Science Service

COMPLETE radio control of the electrical substation at Tipton, Ind., supplying a city of 5,000 population, has been established. Radio waves sent from Kokomo control the switches, and through them the light and power of the community. This is believed to be the first instance of this kind in the United States. Two transmission lines to Tipton are maintained from Kokomo and Noblesville. In case of interruption on either, such as might be caused by storms, the supply can be resumed from the alternative source. Heretofore, the operation of oil switches, used to change the connection, has necessitated the constant presence of substation attendants who have received their instructions by telephone from Kokomo. The telephone has sometimes been put out of commission by storms. Under the new system, if trouble develops on either of the lines, it is instantly observed on the powerhouse instruments at Kokomo and an operator sends out high frequency waves which open the oil switch. The special wave length used is outside broadcasting range. The waves are received by antennae at Tipton and transmitted to a five-tube receiving set and amplifier. They are then carried to a series of selector relays which in turn operate the storage battery switches.

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SCIENCE NEWS

THE EXTRACTION OF GOLD FROM SEA WATER

Science Service

PROFESSOR FRITZ HABER, of the University of Berlin, and inventor of the Haber process for the fixation of nitrogen, who created somewhat of a sensation some time ago with the announcement that he had devised a method of extracting gold from sea water, is now in the United States following this same line of research.

Professor Haber has requested officials of the United States Bureau of Fisheries to furnish him samples of the coastal waters of the North American continent for analysis. He explained to them that he does not consider his experiments commercially valuable and is pursuing them only with the hope of increasing scientific knowledge. The actual procuring of gold from sea water is an accomplished fact, but the quantities are so minute and the expense so great that he believes the process never can be made profitable.

Professor Haber expects to discover the interrelation of waters, the courses of ocean currents, and the history of various sections of the sea through the mineral deposits. The amounts of mineral, whether gold, silver or less valuable minerals, differ according to geographic location of the water and in many cases this difference is very marked. Professor Haber believes that the analysis of water as to its mineral quantities may prove a valuable asset to oceanography, just as analysis of rocks is valuable to the geologist in tracing the history of different sections of the country.

It was indicated that the Bureau of Fisheries may comply with Professor Haber's request and that the cooperation of other government departments dealing with the ocean may be asked.

The best available data at present on the presence of gold in sea water gives the following figures for different locations, bearing out Professor Haber's claims of wide variation according to locality. Deep sea water from the Atlantic Ocean has from 0.015 to 0.267 part of gold per million parts of liquid; water from Christiania, Fjord, Norway, from 0.005 to 0.006; from the coast of New South Wales, 0.032 to 0.065; and from the coast of New Zealand 0.005 part of metal per million parts of sea water. On land the lowest gold deposits which it has been found profitable to operate contain about 0.14 part of gold to per million parts of gravel which does not have to be crushed to extract the precious metal. The granites of California and Nevada have about 0.37 parts of gold per million; the sandstone, 0.03, and the limestone 0.007. It will be noted that some sea water contains nearly twice as much gold as the lowest grade gold deposit on land found profitable to operate.

WHITE INDIANS

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AN expedition to penetrate unknown territory of Panama occupied by the White Indians discovered this spring by R. O. Marsh, American civil engineer and explorer, is now being organized here with the cooperation of leading scientific institutions.

The Marsh expedition, which returned to the United States in July, bringing with it three White Indian children and five brown Indians of the region, explored a large area of territory never before entered by white men. But the country occupied by large settlements of the White Indians was not entered, though flown over by airplane. It will be the objective of the party to leave this country in January.

The party of Darien Indians, including the two White Indian boys, Marguerite, a fourteen-year-old White Indian girl, her father and mother, both brown Indians, and three grown brown Indian men, one of them a leading chief, has spent the summer at Mr. Marsh's summer home near Prescott, Ontario, on the St. Lawrence River. The party is now *en route* to Washington to be presented to President Coolidge and studied by the scientists at the Smithsonian Institution, the U. S. National Museum, National Research Council and the Carnegie Institution of Washington.

In the summer of 1923 Mr. Marsh, while exploring in the Darien region of Panama, saw and photographed at long distance seven White Indians who had come to a settlement in the lower waters of the Chucunaque River. Legends of large White Indian settlements led him to equip and head a scientific expedition to explore the unmapped country into which the Indians have previously allowed no white men to penetrate. Before the explorations by land, Mr. Marsh, with the cooperation of the U. S. Army, conducted an airplane reconnaissance of Darien that revealed major mistakes in existing maps.

The San Blas Indians, which occupy the Atlantic coast of the Darien region, have never heretofore allowed white men to stay overnight within their territory. Mr. Marsh entered the country from the Pacific side and after a hard journey up the Chucunaque River and over the San Blas Mountains, arrived at the "back door" of the San Blas tribes. By tactful treatment of the Indians and by furnishing them medical assistance, he finally won the confidence of the chiefs. Until he got the cooperation of the Indians he was unable to see even one White Indian at close range; once the San Blas Indians were won as friends, four hundred White Indians were summoned for Mr. Marsh's inspection and he was allowed to bring three of the children to the United States.

Among the brown San Blas Indians of the Darien coast the White Indians are outcasts. They are forced to live in segregated settlements on the south or Pacific side of the mountains along the coast. White Indian children are sometimes born to brown Indian parents who are of a distinct and stockier build than the typical San Blas Indian and who have White Indian ancestors. These white children are allowed to remain in the coast settlements only until they are old enough to look out for themselves. Then they are banished and sent into the White Indian settlements up in the mountains.

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The anthropologists,, ethnologists and biologists who have examined the White Indians have been unable to agree upon any cause for their white skin, hazel-brown eyes, yellow hair and red gums combined with Indian features of a superior type. Among the theories of causes and origins that have been suggested are:

(1) The White Indians are called albinos or partial albinos. This is a name that does not explain their origin nor does it take into account the difference that exists between the White Indians and the typical albino occasionally seen among other races whose hair and eyes are totally devoid of pigment. Some anthropologists have called the White Indians albinos, while other anthropologists and biologists declare that they do not exhibit albinism as they understand it.

(2) Some disease or pathologic condition has prevented pigmentation and this lack of coloring matter in the skin has become so fixed in the race that it is inherited from generation to generation as an acquired characteristic. The White Indians are not sick in the ordinary sense of the word, and the three White Indian children brought to this country by Mr. Marsh are in better health and more mentally alert than the average white child.

(3) The White Indians are the beginning of a new white race, perhaps duplicating what happened many thousands of years ago when the present white race was evolved from dark skinned stock. If this is so, the White Indians are what is known as biologic "sports," a condition of extreme scientific interest because of its bearing on the biological problems of man.

(4) The White Indians are the result of a mixture of white or Nordic blood with the brown Indian blood. If this be so it must have occurred many years before Columbus discovered America, because his records and those of Balboa and later explorers tell of White Indians in Central America and Panama at the time of their explorations. One suggestion is that the Vikings and Norsemen who discovered and settled New England in the twelfth century found the climate too cold for them, took to their ships, went south and mixed with the Maya and Aztecs of Mexico, who later emigrated to Panama, becoming the ancestors of the present White Indians. There are records also of a Welsh nobleman sailing with a large company in the direction of America in 1207 and some believe that an admixture of these early voyagers resulted in the White Indians seen by Balboa and now discovered by Mr. Marsh.

Frankly, scientists are unable to determine the cause and origin of the White Indians, although they consider that Mr. Marsh's explorations have resulted in a major ethnological and anthropological discovery. Dr. Aleš Hrdlička, of the U. S. National Museum, remarked that the phenomenon deserves a thorough scientific investigation, and that Mr. Marsh deserves the thanks of American and British anthropologists for having brought to their attention a subject of considerable scientific interest and importance.

The 1925 Marsh expedition to Darien including, it is hoped, geneticists, ethnologists and anthropologists, will have the task of solving this unique racial mystery. Mr. Marsh intends to take the five brown Indians back to Darien with him, but he hopes to be able to keep the three White Indian children in this country and educate them in American schools.

THE DEPLETION OF WOOD PULP RESERVES

Science Service

AMERICANS no longer can look upon the cheap daily newspaper as something inevitable every morning and evening. An extensive research just completed by the United States Forest Service has brought out alarming statistics on the depletion of wood-pulp reserves in the United States.

American paper requirements now exceed eight million tons a year, or 56 per cent. of the world consumption. Wood constitutes 90 per cent. of the raw material from which this is manufactured. In 1922, 9,148,000 cords were required. American forests to-day supply only 49 per cent. of this wood. As recently as 1899 they supplied 83 per cent. Of the amount used in newsprint production, the domestic supply furnishes only one third. Canada supplies the pulp wood for 37 per cent. of our entire paper requirements. The forests of the older lumber sections of the United States are being cut much more rapidly than they are replaced by new growth. In most regions the original timber supplies have been greatly reduced.

The problem, as stated by the Forest Service, is to secure annually from our own forests more than a million cords additional to offset pulpwood imports, approximately five million cords to offset pulp and finished paper imports, and to insure a sufficient growth to supply the needs of the future. It is estimated that a total of about 15 million cords will be required for this purpose by 1950.

Three possible solutions are suggested by the government: *First*, new or modified pulping processes may increase the number of species available for paper. Pine or larch, it is suggested, may be made to take the place of spruce, fir and hemlock in sulphate-pulp production. *Second*, paper manufacturing must be conducted more economically. Reduced pulping waste in the chemical process, re-use of waste paper to a greater extent, and more coordination between the lumber and sawmill industries, must be aimed at. Only about 45 per cent. of the original wood weight now appears as pulp. Re-use of waste paper has grown to 29 per cent. of our total production, but it can be increased to furnish a much greater contribution than its present 1,850,000 tons a year.

Finally, the Forest Service states that the main reliance in ultimately meeting our pulp wood requirements must be placed on the growing of timber. The possible margin of growth on our present area of forest land, under intensive forest management, over the present drain, would ultimately amount to about 12 million cords of the pulp species. To this could be added about 11 million cords now lost annually by fire and disease. To this could be added about 2,000,000 cords annually from Alaska. Out of this total could be met the 10½ million cord difference between the present cut from

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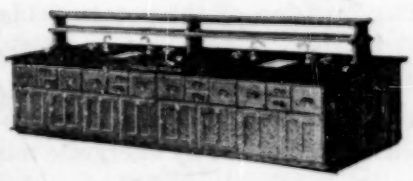

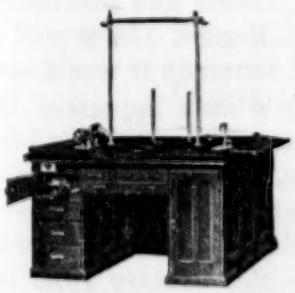

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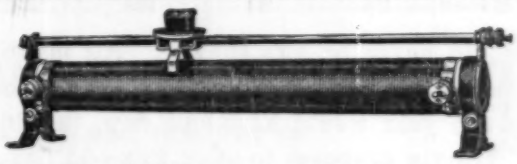

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REFORM OF THE CALENDAR

Science Service

A NEW arrangement of the calendar, embodying the ideas of Dr. Charles F. Marvin, chief of the U. S. Weather Bureau, was presented before the meeting of the International Geodetic and Geophysical Union, which closed at Madrid on October 10. Dr. Marvin's representative at the meeting was Professor H. H. Kimball, also of the U. S. Weather Bureau.

Dr. Marvin has long believed the present division of the year into twelve months of unequal length is awkward and should be changed. He likens the present calendar, in which the length of the months varies from twenty-eight to thirty-one days, to a confusing yardstick which would sometimes measure thirty-six inches and sometimes thirty-eight or thirty-nine. He believes that much convenience would be gained by both business and science if months were always of equal length and always began on the same day, and he has devised a calendar on that basis, which was presented before the meeting here.

Professor Marvin's calendar is very simple. The year is divided into thirteen months instead of twelve, and each month has exactly twenty-eight days. Each page of his calendar would look like this:

Sun.	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

There would never be any change. All months would have the same days on the same dates, forever. This thirteen-month year would have one day, the 365th, left over. Dr. Marvin proposes to stick this odd day in somewhere between Christmas and New Year's, as an additional holiday. In leap years another day would be inserted between two midsummer months, as a midsummer holiday.

A number of advantages to business in the proposed arrangement are pointed out. The beginning of each month, and the beginning of the year, would always be the same, also the beginning of a week—a considerable matter in the ordering of office routine. People who are paid by the month or semi-month would always have Saturday for pay day. Legal holidays that now shift, like Christmas, New Year's and July 4, would always come on the same day of the week. Religious festivals that move about, like Easter, could be given a definite date. Authorities of the Roman Catholic, Eastern Orthodox and Anglican churches have agreed that a fixed date for Easter could be arranged.

The last calendar reform occurred in 1582, when Pope Gregory XIII revised the old Julian calendar, which had been in use since the time of Caesar. The Julian calendar had allowed too many leap years, and in the course of centuries an error amounting to eleven days had crept in. It took some time for Gregory's calendar to be adopted, but long before the beginning of the nineteenth century all western nations except Russia were using it. Russia clung to the Julian calendar until 1923, when the Soviet government brought its dates into agreement with those of the rest of the world. The calendar adopted in Russia last year contains one very slight modification, designed to offset a minor inaccuracy left in the reckoning by Gregory; but this is of interest only to astronomers, since the change is not to take effect until the year 2000, and the error is so small that it will not amount to a full day until the year 4600.

The proposed new calendar is even more closely calculated than the latest Russian model. But one unescapable source of error still intrudes. It is known now that each year is shorter than the one preceding by a very small particle of time. The difference amounts to fifty-three one hundredths of a second in a century. Professor Marvin states that by the time this unavoidable error introduces a difference of one day in his method of reckoning, it will be the year 13000 A. D.

ITEMS

Science Service

EXPERIMENTS on the milk ration for undernourished children in the public schools have shown that both bodily and mental vigor are increased thereby. A pint of milk daily, in addition to their usual meals, was provided for 30 children, 15 boys and 15 girls. Measurements of height and weight were taken every two weeks and the hemoglobin percentage in the blood estimated. This percentage quickly rose about 20 points, after which the children started to put on weight much more rapidly than 30 other well-fed children who were not receiving the milk ration. After two months both groups were given the ration. The increase in hemoglobin was not so great during the second two months but was much greater for the poorly-nourished than for the well-nourished children. The gain in weight of the poorly-nourished children was less than during the first period and considerably less than for the other group. When the milk rations were stopped there was a noticeable diminution in the brightness of spirits of both groups.

THE invasion of the potato fields of Germany is threatened by the Colorado potato beetle. This destructive insect pest has found a foothold at various times and places in eastern Europe, but has hitherto been held in check or driven out by energetic measures. Since the war, however, it has successfully invaded and established itself in a large area in southeastern France and threatens to extend its invasion into central Europe. Once well established in the potato fields of Germany it would cause great losses to one of Germany's most important food crops. Ernest Janisch, of Berlin, claims that the beetle was brought to Bordeaux, France, in ships bringing troops from America. This recalls the fact that American entomologists believe that the Hessian fly, one of the worst pests in America, first came to this country from Germany in the straw brought by Hessian troops with their horses to America during the revolutionary war.

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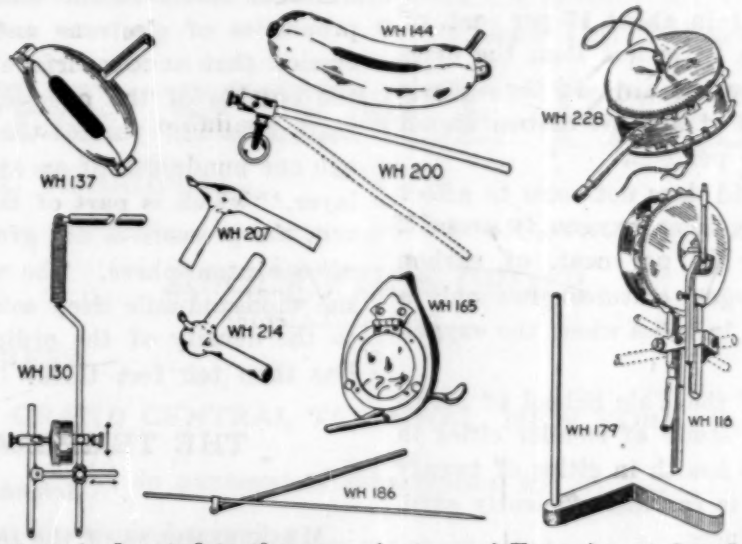

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SCIENCE NEWS

THE AMERICAN PUBLIC HEALTH ASSOCIATION

Science Service

AT the meeting, during the first part of this week, of the American Public Health Association, in Detroit, the importance of immune carriers—persons who bear the germs of diphtheria about with them, though they do not "come down" with the disease—was emphasized by Dr. W. R. Stokes, Dr. J. F. Hogan and C. L. Ewing, Health Department of Baltimore, who have studied this question in Baltimore and have compared that city with seventeen other large cities in the United States. They showed that about one person in every thousand carries diphtheria infection without himself being affected by it. But among undiseased persons who have been in close contact with diphtheria patients this proportion is increased tenfold, rising to about one in one hundred. It is found that when these carriers are watched, and not permitted opportunities to act as unconscious agents in the spread of the disease, the death rate from diphtheria falls off materially.

Drs. F. G. Novy and M. H. Soule, of the University of Michigan, pointed out that the bacillus of tuberculosis needs plenty of air to breathe, and most bacteriologists who grow the organism for study purposes unintentionally smother it.

Although it is recognized that the tubercle bacillus needs air, it is not generally realized that several hundred cubic centimeters of air is necessary to produce a good growth in a culture tube. The usual laboratory practice of sealing the tubes, they say, may completely shut off the needed supply of oxygen.

Like higher organisms, the bacillus returns carbon dioxid for the oxygen it receives. A sealed culture tube filled with air will come to contain about 17 per cent. of carbon dioxid, which is only a little less than the original concentration of oxygen in the air. If the tube is filled with pure oxygen instead of air, the carbon dioxid content will run as high as 86 per cent.

The presence of carbon dioxid does not seem to affect the vigor of the germ, if only some oxygen is present. In an atmosphere containing 90 per cent. of carbon dioxid and 10 per cent. of oxygen, cultures grew only a little less rapidly than they did in tubes where the oxygen supply was 40 to 60 per cent.

Professor Ira V. Hiscock, of the Yale School of Medicine, who has made a detailed study of smaller cities in Connecticut, stated that public health in cities of twenty to thirty thousand population is far less efficiently safeguarded than it is in larger places.

In communities of this size, he pointed out, there is a lack of full-time employees, trained in modern health practice. Too frequently the combination job of health officer and school physician becomes a political "plum." The appropriations for official health work in over nine tenths of these towns are inadequate for the development of a complete health program.

Volunteer work by partly qualified nurses, cooperation by parents in health undertakings fostered through the public schools and a gradual awakening of public feeling promise possible improvement in the future.

The needs of inland populations for iodine in diet or water supply, to prevent the incidence of goiter, were the subject of a report by a committee on nutritional problems, under the chairmanship of Dr. Henry C. Sherman, of Columbia University. Dr. Sherman pointed out that in regions near the seashore the iodine necessary for good health is borne inland to considerable distances as spray on the wind. But in regions remote from the sea or cut off by mountains, there arises a lack of iodine, and a consequent increase in the occurrence of goiter. Very little iodine is necessary to prevent goiter—only about one part in three million parts of the body weight. This may be supplied, in inland places, by adding slight amounts to city water, by the addition of iodine salts to common salt, or in other ways introducing it into food, or by using in the diet small quantities of sea plants which have been found to be rich in iodine.

SURFACE PRESSURE OF THE SUN

Science Service

WHAT pressure does the sun's "atmosphere" of gaseous metals exert on its surface?

Drs. H. N. Russell and J. Q. Stewart, astrophysicists at Princeton University, have evidence that it is very low—so low, indeed, that pressures of the same magnitude may be produced on earth only artificially, and are then reckoned as fairly well-developed vacua.

By mathematical manipulations of the known facts about the solar spectrum, the degree of brightness of different levels in the outer coat of the sun, and the properties of electrons and atoms, they reach the conclusion that at the surface of the photosphere, which is the outside of the opaque, and apparently though not really, "solid" part of the sun, the pressure is less than one one hundredth of an atmosphere. In the "reversing layer," which is part of the gaseous envelope about the sun, the pressure is not greater than one ten thousandth of one atmosphere. The whole amount of material in the thousand-mile deep solar atmosphere, if compressed to the density of the ordinary air, would make a layer less than ten feet thick.

THE TEMPERATURE OF MARS

Science Service

MEASUREMENTS of the temperatures of Mars, taken at the Mt. Wilson, California, and the Flagstaff, Arizona, Observatories are not in complete agreement.

According to the observations at Mt. Wilson, the noonday temperature on the Martian equator is about 10 degrees above freezing, that is, about 42 degrees Fahrenheit, or the temperature of a late February day in the temperate regions. The Flagstaff figure is higher, about

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20 degrees Centigrade or 68 degrees Fahrenheit, like a temperate-zone April day. The Mt. Wilson observations show that the temperature of Mars depends largely on the direct rays of the sun, as do temperatures on the mountain-tops of the earth, for the average morning temperature, between Martian sunrise and 9 A. M., is about 10 degrees Fahrenheit, while over the south polar cap a low point of 95 degrees below zero is reached.

The Flagstaff scientists do not give exact figures except for the noon-day temperature, but they say, "these radiometric measurements show that the equatorial zones are much warmer than the polar regions which emit practically no planetary radiation; the morning side of the planet is at a lower temperature than the afternoon side which has been exposed to the sun's rays for a longer time; the dark regions are at a higher temperature than the light ones, and a gradual rise in temperature of the southern hemisphere, where summer is now advancing, is recorded."

EFFECT OF RADIUM EMANATION ON ETHANE

Science Service

RADIUM emanation, acting upon ethane, a constituent of natural gas, has changed it into an oily liquid, probably octane, in the laboratory of Drs. S. C. Lind and D. C. Bardwell, of the U. S. Bureau of Mines. Octane is a light, volatile, highly combustible liquid, and is one of the principal ingredients of ordinary naphtha.

Whether there are commercial possibilities in the process, the discoverers did not wish to conjecture; the experiments so far performed are only preliminary. They are continuing their investigations.

This is the first instance on record of the conversion of a lower hydrocarbon to a higher one by the use of radium emanation. A somewhat similar occurrence took place, however, several years ago, though it was never reported to the scientific world. Professor B. B. Boltwood, of Yale University, and Sir Ernest Rutherford, of the University of Cambridge, England, found that the same radium emanation changed ordinary soft paraffin into a form of paraffin so hard that it would melt only at a temperature nearly great enough to make glass red hot.

The conversion of lower hydrocarbons into higher forms depends on driving off part of the hydrogen. Hydrocarbons, both liquid fuels and gases, are made of carbon and hydrogen in varying proportions. The larger the proportion of carbon the "higher" the hydrocarbon. Ethane, for example, the material with which the present experiments were begun, contains two parts of carbon and is a gas. Octane, which is a liquid, contains eight parts of carbon and eighteen of hydrogen; or a proportion of four to nine, as compared with one to three in ethane. Considerable quantities of free hydrogen were given off during the experiment, showing that the gas was being partly broken up by the radium bombardment, and then reorganizing into the higher form, or octane.

One possible value of the discovery may be its aid in understanding the formation of natural gases and oils in the earth. The alpha radiation of radium is present everywhere in the rocks, and it may therefore have had a good deal to do with the building up of petroleum deposits from the organic masses left behind by the life of past geologic ages. One difficulty remains to be explained away, in the opinion of the two investigators. Petroleum and gas wells do not give off hydrogen. In any event, however, the discovery is one of the most important of recent developments in hydrocarbon chemistry.

THE ANCESTRY OF THE HORSE

Science Service

THE missing link between modern horses and their long line of fossil ancestors from which they were evolved has been discovered by Dr. W. D. Matthew, of the American Museum of Natural History. Dr. Matthew has given his find the name of Plesippus or near-horse.

The skeleton was dug up from the Blanco formation of Texas. It shows characteristics like those of the horses of the Ice Age, which were practically horses as we know them to-day, and also like the less horse-like animals further back on the horse's family tree.

The legs are much larger and more robust than those of the last of the pre-horse ancestors of the modern horse and the skull is also long like that of the Dobbins of to-day, in contrast to the shorter head of the earlier equids. The skeleton, however, had teeth more like those of the fossil ancestors than their living descendants. Tiny vestiges of a fifth toe are also present.

"The series of American ancestors of the horse is one of the classic examples of evolution provided by the fossil record and the most complete and convincing among the mammals," said Dr. Matthew. "Nevertheless, it is well recognized by those who have made a special study of it that while the broader lines of descent are beyond reasonable question, there are definite gaps between some of the successive stages."

This discovery fills one of the three important gaps previously existing in the horse's family tree, which is nearest to recent times. The genus represented, Dr. Matthew claims, is certainly the desired intermediate stage between Pliohippus and Equus, the modern horse, although further study may show that it is a little off the direct line of descent.

COLOR-BLINDNESS

Science Service

ONE portion of the eye of an individual may be color blind while another portion is not. In one eye there may be a spot on the retina, capable of distinguishing certain colors and in the opposite eye of the same individual the corresponding spot is not able to distinguish colors. These are the deductions made by Dr. F. M. Baldwin, professor of physiology at Iowa State College, at Ames, after a series of experiments on color-blindness in the human eye.

The variations are caused by the variation in distribution of the photo-chemical substances in the retina. An

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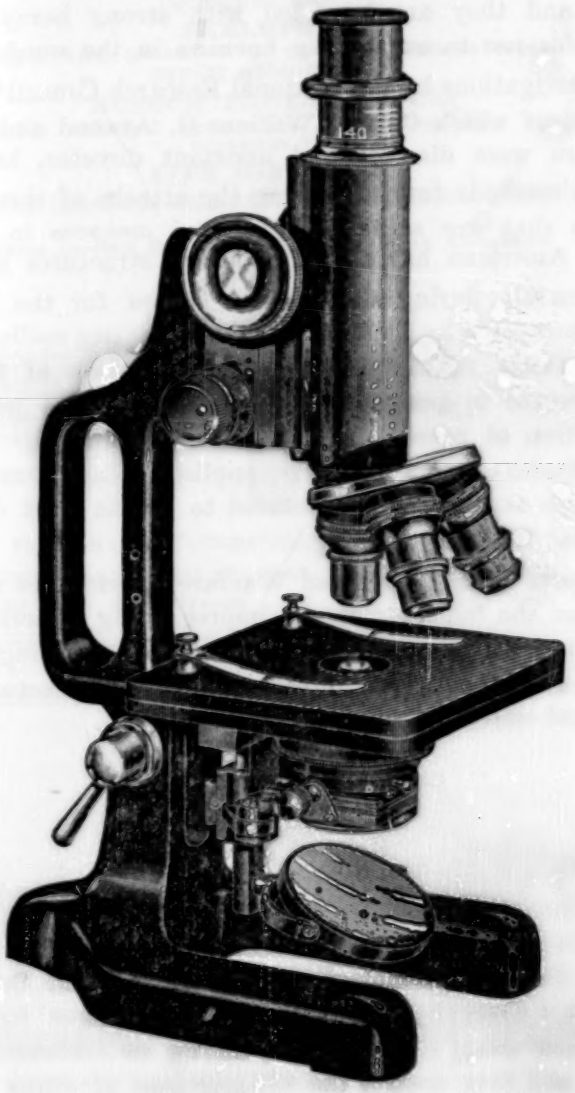

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engineer might be able to pass a railroad test for color-blindness and yet the range of his eye in distinguishing colors be limited to the exact focal point of the eye. An engineer with such a limited range of color distinction would be a dangerous man to have at the throttle of an engine, according to Dr. Baldwin, because of the great speed of the train and the variation in light, both of which would make it possible for him to fail to read his signals properly.

Near-sighted persons have a bigger field of color discrimination than do far-sighted people. According to all creditable data color-blindness is more prevalent among men than women. Approximately five per cent. of all males are unable to distinguish one or more colors, while only about one per cent. of females are so affected.

THE DAMAGE DONE BY MARINE BORING ANIMALS

Science Service

METHODS for defense against a persistent and stealthy submarine foe preying upon wharfing have been developed through researches of the National Research Council's Division of Engineering and Industrial Research.

The foe consists of great armies of shipworms and other marine boring animals, the original exponents of submarine warfare. They inflict millions of dollars of damage to docks, wharves and piling, and operate in nearly every seaport of the United States.

Twenty million dollars of damage done to docks, wharves and other marine piling in San Francisco Bay led to the formation of a committee of investigation which brought to the attention of the National Research Council the importance of waging war against these submarine enemies, the shipworms and other marine wood-boring animals.

The knowledge and facilities of biologists, chemists, engineers and governmental organizations, such as the Chemical Warfare Service, Army and Navy departments, Bureau of Fisheries and the Lighthouse Service, were marshalled by the council. Test boards were established all along the Atlantic, Gulf and Pacific Coasts, including Alaska and the Hawaiian Islands, for the purpose of studying the life habits and breeding seasons of these borers in order effectively to counteract their ravages.

Money and service representing a total value of about two hundred thousand dollars, derived from government organizations, railway and steamship companies, industrial concerns, the Engineering Foundation and the National Research Council were expended in the investigation, which has now been brought to a close, and a comprehensive report has been issued by the National Research Council in which the effectiveness of old methods and the new preservative compounds, suggested by the Chemical Warfare Service, are discussed.

These destroyers of man's engineering works are of two general kinds, one related to the clams and oysters and one to the lobsters and crabs. Best known is the Teredo, which belongs to the group of borers related to the oyster and clam. It does its damage by boring with its shells into the wood which it enters during its larval stage through an opening not larger than a pin point. One large mother Teredo may produce one hundred million eggs, each about a five hundredths of an inch in diameter, in less than two years. Some species of these shipworms grow to be four feet long and an inch in diameter. The more common species, though smaller, about as large as a lead pencil, will completely honeycomb wooden piling within the few months of the active summer season.

Certain minute crustacea are the other enemies of wood. These frequently live 300 to 400 to the square inch, and they are provided with strong horny-tipped jaws for use in excavating burrows in the wood.

Investigations by the National Research Council's Committee, of which Colonel William G. Atwood and A. A. Johnson were director and assistant director, have revealed methods for minimizing the attacks of these shipworms that are actual or potential menaces in nearly every American harbor. Temporary structures may be built safely during the inactive season for the worms. Piles protected by metallic armor or scupper nailing have given fairly reliable results. Impregnation of timbers by creosote is generally regarded as the best practical protection at present. Copper and vitrified pipe casing are effective when properly applied. Cast iron piers, although expensive, are declared to be the most durable material for marine piling.

Experts of the Chemical Warfare Service are now at work on the improvement of impregnating materials for poisoning the borers, and they are also attempting to develop a method for protecting existing structures by chemical methods.

ITEMS

Science Service

A DOUBLE use has been found for one of man's fungus allies in his fight against insect pests, according to Dr. E. W. Berger, entomologist of the State Plant Board of Florida. Orange growers in that state have for some time been using a red fungus, known as Aschersonia, to infect and thus control the whitefly pest of citrus fruits. A similar insect has been causing serious trouble for sweet potato growers, and now the discovery has been made in several localities that the same fungus attacks this pest also. Tests are now being made in the field to determine whether the fungus can be used economically on a large scale to protect the sweet potato crop.

THE eating of bones is responsible for the spread of "down-in-the-back" disease among cattle, Dr. Hubert Schmidt has concluded after a series of experiments. Dr. Schmidt, who is a state veterinarian, discovered accidentally that many cattle are bone eaters and followed up this discovery by experiments. This discovery concerning the perverted appetite of cattle was made when a farmer told him that cattle had eaten a cow skeleton which was to have been saved. The discovery may solve the problem which has cost Texas cattle raisers many thousands of dollars.

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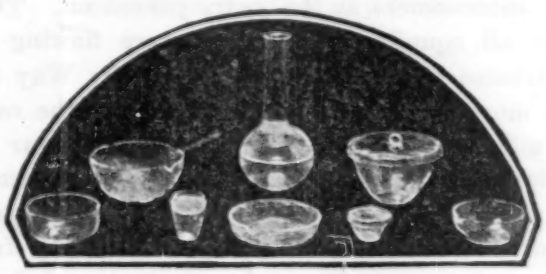

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SCIENCE NEWS

THE SUN'S PLACE IN THE UNIVERSE

Science Service

STATISTICS of the stars, which are becoming increasingly valuable each year as the astronomer finds new and illuminating data continually coming to hand, do not give our sun such a flattering position in the universe as we might wish. A small, yellow, dwarf star is its rating in a universe of some hundreds of millions of stars, similar in size and appearance to many million other stars; its position fifty light years above the central plane of the Milky Way and fifty thousand or more light years from its center, in the midst of a local star-cloud, not over three thousand light years in diameter, which is more or less permeated with and enveloped by vast expanses of dark nebulous matter.

It was but a few centuries ago that man looked upon the sun as an attendant of the earth which was then held to be the center of creation. Then it came about, surprisingly, that the sun was after all the ruler of its own system and the earth an attendant of the sun, a rather puny one at that compared to some members of the solar system. It was a thought to which the human race has not yet completely adjusted itself. Still man clung to the belief that the sun was the center of the universe, for the distances and distribution of the stars were unknown. It was the general idea that the stars were all equally far away, arranged in a sort of spherical shell with the sun at the center. Another unpleasant shock was still to come to the geocentrically inclined members of the human race. New and surprising facts about this sun of ours were gleaned from the life studies of many astronomers as the years passed on. The stars were not all equally distant, but were flowing to and fro in streams in or parallel to the Milky Way and the sun was moving onward through space at the rate of a million miles a day, one of the units in a star stream. The distances of the stars turned out to be tremendous, inconceivable. The nearest star was something like twenty-six trillion miles away. Its light took four and a third years to reach us though it traveled 186,000 miles every second. Other stars were found—ten, a hundred, a thousand times more distant. Each star had the comfortable elbow room of several trillion miles on the average, its distance from its nearest stellar neighbor. Old, conservative ideas of the universe were completely upset. As a last straw for the old geocentric theorists came the discovery of the present decade that we are something like fifty thousand light years from the center of the universe, or possibly *one* universe, which consists of the vast lens-shaped aggregation of hundreds of millions of stars known as the Milky Way or Galaxy with its center far away in the direction of the star clouds of Sagittarius.

Though Dr. Harlow Shapley's estimate of three hundred and fifty thousand light years for the diameter of the Milky Way has not passed unchallenged by some astronomers who consider it of the order of ten times too large, the general weight of the evidence at present seems to be in favor of this greater estimate of the size of the Milky Way. It is to the Milky Way system of stars that our own sun belongs and through it we are moving with the sun, about which we circle, at the rate of a million miles every day, six million million or six trillion miles in 15,750 years.

At that rate it would take us pretty close to eight hundred million years to reach that coveted position at the center of the universe. But the sun is old, at least several billion years old, it is suspected, and, who knows maybe we were there once in past ages and will get there again some day!—*Isabel M. Lewis.*

SWEDISH ANTHROPOLOGICAL EXCAVATIONS

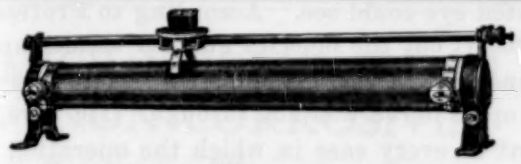
Science Service

THREE skeletons of persons who died 4,500 years ago in Sweden are among the many valuable relics of the Stone Age which Swedish archeologists have unearthed this summer in their assiduous efforts to reconstruct Sweden's prehistoric past. Other objects among the new finds now being studied are weapons, tools and pottery from the Stone Age, funeral urns, bronze axes, swords, etc., from the Bronze Age, remains of workshops in the Iron Age, hoards of gold and silver treasures amassed in the Viking Age, and various relics that shed light on medieval life in Sweden.

Another interesting find, made earlier in the summer while excavating in the market-place of the ancient town of Visby, were the remains of a workshop in which bone objects had been made. Antlers of moose and deer in various states of manufacture, and various horn objects such as combs, chisels and punches, were found. These objects, it is said, belong to the latter part of the Iron Age. Relics of medieval times, when Visby was in her prime, are frequently found, the latest being a domestic aquarium, in which, according to custom, fish were preserved alive until the time when they were to be served up in a favorite dish for some merchant prince of the city. Four or five aquariums of this type have previously been found in Visby.

A curious and unique object recently found at Laholm, in the province of Halland, is a flint saw from the Stone Age. And another object of special interest in the study of Stone Age civilization in Sweden is a grindstone for sharpening stone tools and weapons, which has been found this summer near Piteaa, on the Gulf of Bothnia. Piteaa is only about sixty miles south of the Arctic Circle. The curious appearance of this grindstone has led the experts to the theory that it was once used by the Lapps as an idol—a strange elevation in service of a common object that had lost its practical utility at least 3,000 years earlier.

At Laholm were also found interesting relics of the Bronze Age, dating back to 1,500–1,000 B. C. The finds include a beautiful bronze sword nearly two feet long,



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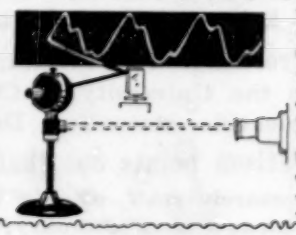

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and two exquisitely shaped burial urns, of which one was about one foot in diameter. Bronze Age antiquities of great value will probably be unearthed at Sohoeg, between Trelleborg and Falsterbo, on the most southerly tip of Sweden. Bronze axes were found on this site half a century ago, and excavations now begun in earnest have already yielded hundreds of objects. The finds date back to about 1,500 B. C. The prehistoric burial grounds at Sohoeg are believed to be haunted, and it figures in a great number of ghost stories and weird legends that are a part of the folk lore of this region.

Contrasting with the severe and gloomy character of the preceding ages in the civilization of Sweden is the picturesque and romantic Viking Age. The Viking relics found this summer include ornaments and coins of silver and gold that testify to the far-flung adventure and commerce of the daring seafarers of the ninth and tenth centuries A. D. Thus at Igeloesa, in Skaane, a farmer recently came across a buried treasure of silver money, 2,037 coins in all. He has just delivered the treasure to the government, and, according to law, has received the value of the silver in weight, or about $86.00, plus one eighth for the "antiquity value." Most of these coins are English, dated during the reign of Aethelred II, 978 to 916 A. D., and are doubtless part of the tribute money which the Viking raiders of that day exacted from England. The other coins are Irish, German and Arabic. A lot of Arabic coins of this period have also just been found in Ytterenhoerna, in the province of Soedermanland. Between twenty and thirty thousand Arabic coins in all have been found in Sweden and testify to the close commercial relations which the Vikings had with the Near East, as well as with Western Europe.

DO TRANSPLANTED EYES SEE?

Science Service

Do transplanted eyes see? Can the eye of an animal, taken out of its socket and transplanted into the head of another animal, or into the opposite side of the same head it was taken from resume its normal function?

Scientists of two continents are in dispute over the experiments of Dr. Theodore Koppanyi, at the University of Chicago. Obviously, if Dr. Koppanyi's experiments are successful, they may eventually be of immense importance in surgery. But Professor Joseph Imre, Jr., Dr. Koppanyi's countryman, claims that successful transplantation has not been accomplished, while Professor A. J. Carlson, in charge of the Chicago laboratory where Dr. Koppanyi is working, states that the experiments have had at least partial success.

Numerous newspaper reports relative to the possibility of transplanting the eye aroused the controversy among scientists which comes to light in the *Journal* of the American Medical Association.

Professor Joseph Imre, Jr., head of the department of diseases of the eye in the State University of Pecs in Budapest, points out that he considers it his moral duty to relate the results of investigation in this connection. His investigations have shown him that Dr. Koppanyi, a biologist, performed experiments on rats and rabbits in attempts to find out whether or not an animal with a transplanted eye could see. According to Professor Imre, Dr. Koppanyi cut the muscles and cut tissues around the eyeball and left the eye in place, and there was no proof that the optic nerve was cut through. He says, furthermore, that in every case in which the operation was witnessed by physicians and the eyeball was removed from its place, there never was any other result but complete destruction of the eye.

Professor Imre believes that even if the optic nerve could grow again, a condition which has never been established, and even if there were a possibility of transplanting a complete eye from one man to another, the question could not have any practical importance, because no physician should be allowed to, and no physician with any conscience would remove an eye with good vision for making a rather uncertain experiment.

Following the publication of Professor Imre's article, Professor A. J. Carlson, of the department of physiology in the University of Chicago, replied on behalf of the scientific status of Dr. Koppanyi's work. Professor Carlson points out that Dr. Koppanyi has been on the research staff of his laboratory in the University of Chicago since January, and that such newspaper stories as have appeared have not been authorized either by Dr. Koppanyi or by the laboratory. Experiments have been made on spotted rats, and the transplanted eyes have undergone varying degrees of change from complete destruction to mere cloudiness of the tissues. The cause for failure in most cases is believed to be secondary infection.

In the most successful experiments, the transplanted eye appears normal in size; the cloudiness clears up, and, so far as has been determined there may be some return of vision. Professor Carlson has controlled Dr. Koppanyi's work and believes that it demonstrates definitely that transplantation can be carried out with at least partial success on the spotted rat. He points out that it remains to be seen whether such results can be duplicated in the dog and the monkey, and if this is achieved, there still remains a very high percentage of complete or partial failure which must be converted into success before any one would be justified in attempting any such operation on man.

Supplementing the letter of Professor Carlson, Dr. Koppanyi declares that the charges of Professor Imre that he gave unwarranted publicity to his work, stating that the return of vision is possible, and admitting that the optic nerve was not cut in his eye transplantation experiments, are not true.

INVESTIGATION OF THE WHITE INDIANS

Science Service

THE White Indians of the Darien region of Panama have been given a preliminary inspection by a committee of scientists consisting of Dr. Aleš Hrdlička, anthropologist of the Smithsonian Institution, as chairman; Dr. Charles B. Davenport, of the Station for Experimental Evolution, Cold Spring Harbor, L. I., and Dr. C. W.

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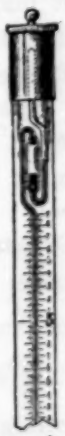

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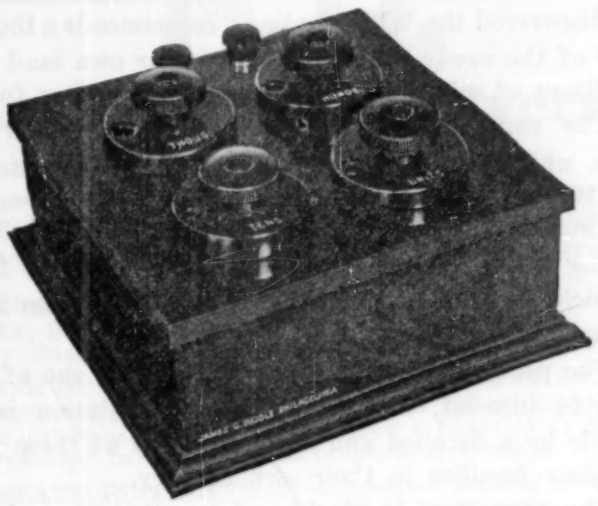

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Stiles, of the U. S. Public Health Service. The committee, in a communication to R. O. Marsh, the explorer who discovered the White Indians, recommends a thorough study of the newly found people in their own land by an expedition of scientists. The committee's letter follows:

"The committee of Drs. Hrdlička, Davenport and Stiles, which you desired to take charge of the study of the 'White Indians' of Panama whom you brought to Washington for the purposes of investigation, held a meeting after these Indians were examined last Friday at which the whole matter was discussed and the following conclusions arrived at:

"The problem of the 'White Indians' is one of much scientific interest, but its satisfactory solution is only possible by a detailed and all-sided study of these people and their families in their own country.

"The committee is of the opinion that these investigations should be conducted simultaneously by anthropology, genetics and pathology.

"In order that the results may be satisfactory, it is requisite that the research should be carried on by experienced and reliable men, whose findings will be accepted with confidence by their colleagues.

"The first condition for a successful carrying on of the work should be, in the opinion of the committee, the training during the remainder of the year of two or three of the persons now in your party in the English language and such terms as it may be necessary to use with the Indians. Considerable questioning will have to be done, particularly by the anthropologist and geneticist, which would be quite impossible without well-qualified interpreters. Two of the men of your party, the fathers of Margaret and Alfred, would seem particularly promising in this direction. It is felt tnat the two and one third months remaining of this year would be sufficient to form these men into invaluable interpreters for the scientific party.

"The committee would appreciate a statement from you as to whether or not you desire it to take charge of whatever further work is to be done on these Indians."

Mr. Marsh stated recently that he intended to cooperate in every possible way to facilitate carrying out the recommendations of the committee.

TESTS OF AEROPLANES

Science Service

When an aeroplane reaches a speed of three hundred miles an hour or more, or a great bomber climbs to the clouds carrying a couple of tons, back of the daring pilot are the engineer and the physicist who give him a perfected machine that will respond to the demands he makes on it. Professor Joseph S. Ames, of the Johns Hopkins University, chairman of the executive committee of the National Advisory Committee for Aeronautics, tells in the "Annual Report" of the Smithsonian Institution, shortly to come off the press, of the work of the scientists in the laboratories that makes possible the record-breaking flights.

Two principal methods, according to Dr. Ames, are used in testing improved models of wings and other airplane parts. One, the free-air method, consists in carrying the part to be tested beneath an airplane in flight, with instruments attached to measure its behavior. The other method consists in placing the test parts, built in the designed shape but on a smaller scale than in service models, in a specially constructed tunnel, and driving against them a current of air moving at the airplane speed.

For testing models of high speed airplanes a special type of wind tunnel is necessary, so as to simulate the conditions the planes meet in actual flight. This tunnel is built inside a tank, in which the air can be raised to as much as twenty-five atmospheres, or 375 pounds per square inch.

Research in aeronautics most needed at present, says Dr. Ames, is included under the following heads:

1. Investigation of the properties of propellers operating at a considerable angle to the line of flight. Information must be gained on this point before successful helicopters or machines rising vertically can be built.

2. A greater range of speed for any one airplane, so that it may attain a great flying speed and yet have a slow landing speed.

3. Reduction of the "drag," or resistance of aircraft. Much experimentation in the distribution of weight, arrangement of engine and propeller, position of fuselage, etc., must be carried on to approach a solution of this problem.

4. Greater refinements of wing form, in the interests of greater efficiency and economy.

ITEMS

Science Service

The Highway Research Board of the National Research Council, of which Charles M. Upham is director, is about to begin an intensive inspection of reinforced concrete roads throughout the United States which have been in service for at least five years, with reference to all sorts of climatic and traffic conditions. From this survey an effort will be made to determine the influence of steel reinforcement on the resistance of the slab to traffic, subgrade and climatic conditions; the conditions under which steel reinforcement is especially beneficial to concrete slabs; the effect of a slab design on the efficiency of the reinforcement; the relative initial cost and annual maintenance and renewal charges of plain and reinforced concrete roads.

It seems probable that the British Parliament will forbid the use of formaldehyde in any article of food or internal medicine. A departmental committee appointed to investigate the matter has strongly condemned it as a food preservative. Formaldehyde or formalin solutions are highly efficient as general external antiseptics and disinfectants, but are commonly thought to be too poisonous to be taken internally with safety. The action of the drug is cumulative, so that several small doses taken at intervals may have the same effect as a larger quantity swallowed at once. In the United States, the Federal Pure Food and Drug Act absolutely prohibits the use of formaldehyde in the preparation of any food or drug to be taken internally.

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SCIENCE NEWS

THE MARTIAN POLAR CAPS

Science Service

THE famous polar caps of Mars, often attributed to snow or ice that melts seasonally, are largely due to clouds, haze or other atmospheric phenomena. This is the conclusion of Professor W. H. Wright, astronomer of the Lick Observatory, who took advantage of the recent nearness of this planet to the earth and photographed it by light of different colors.

It is a comparatively dense atmosphere that envelops the ruddy planet, Professor Wright has also discovered. Heretofore the general opinion has been that the atmosphere on Mars is very thin.

Using the great Crossley reflecting telescope, these discoveries have been accomplished through the employment of color screens and photographic plates of special sensitivity, the two being used in conjunction with each other in such a way as to isolate, for the purposes of the photograph, light of a number of parts of the spectrum. The range in color is from the near infra-red, 7,600 Ängstrom units, to the ultra-violet, 3,600 Angstrom units.

"It is found that as the color used in the observations approaches the violet end of the spectrum the surface markings of the planet, excepting the polar cap, fade from the image, and in fact disappear completely with the employment of blue and violet light; the polar cap, for its part, becomes, with these changes, progressively more marked. If, for example, we take light from opposite extremities of the visible spectrum, the infra-red and violet, we find that the one renders a picture rich in detail and high in contrast, while the other supplies an image barren of both, except that the polar cap and a few impermanent features stand out in greater strength. There is another difference between the images recorded by light of these two colors which relates to size. The violet light image is the larger of the two.

"This difference in aspect of the planet when viewed by light of the two ends of the spectrum is interpreted as resulting from the presence of a Martian atmosphere of considerable density that, like the atmosphere of the earth, scatters and absorbs light of short wave-length, such as blue and violet light, but readily transmits the long-waved infra-red light. The infra-red photographs obviously represent the planet's surface, since they record the familiar permanent markings which are seen in the telescope and are known to be part of the planet; while, considered in the light of the foregoing hypothesis, the violet images are photographs of the planet's atmospheric shell, made with the light that it scatters. The fact that the polar caps are exceptionally strong in the supposed photographs of the atmosphere, leads necessarily to the conclusion that they are, to a great extent, atmospheric phenomena, possibly clouds or banks of haze. These may overlie solid caps of smaller dimensions on the surface of the planet.

"The difference in size between the violet and infra-red images serves as the basis of a rough estimate of the thickness of the atmosphere, for the diameter of the atmospheric shell must exceed that of the planet proper by twice this quantity. The thickness, or height of the atmosphere derived in this way is somewhat more than 100 miles, but the result is regarded as only roughly approximate, and of value principally in indicating that the extent of atmosphere is measurable."

The significance of the observations is regarded as lying in their indication that the atmosphere of Mars is comparatively dense, optically at least, and of considerable extent. That the planet has an atmosphere has long been assumed, for one seems necessary to account for the waxing and waning of the polar caps.

PSYCHOLOGICAL TESTS OF AUTOMOBILE DRIVERS

Science Service

WHEN it comes to stopping an automobile quickly, race, sex, color or education do not count. But scientific tests for chauffeurs devised by H. H. Allen, automotive expert of the National Bureau of Standards, and Professor Fred A. Moss, psychologist of the Public Personnel Administration of thhe Institute for Government Research, show that experience and natural quickness do affect the amount of time required for the automobile driver to get his feet into action upon the brakes.

They have devised an apparatus that allows the accurate measurement of the time elapsing between the signal to stop and the application of the brakes. The mechanism is very simple. An automobile of the standard gear-shift type has been equipped with a tachometer, an instrument much more accurate than a speedometer because it records every revolution of the wheels. Two pistols, muzzles downward, are fastened to the running board of the car. The bullet in the cartridge has been removed and red litharge inserted so that when the pistol is fired a red mark is left on the pavement.

When the tachometer registers a certain speed the examiner fires the first pistol. At this signal the person being tested, immediately removes his foot from the accelerator to the brake, automatically discharging the second pistol. The distance between the red marks on the pavement is measured. This distance divided by the speed of driving will show to a thousandth of a second the time required for the response of the driver.

Professor Moss and Mr. Allen have tried the experiment with a group of men and women students from George Washington University, a group from Howard University and a number of taxi drivers.

In the group from George Washington there was very little difference in the reaction of the men and the women, each showing an average reaction of about one half of a second. The individuals in the group varied very widely, one individual having a reaction time less than three times as short as other members of the group tested.

In the group chosen from Howard University the re-

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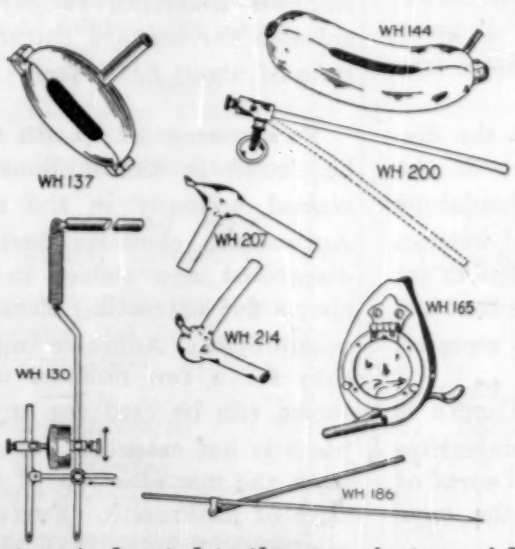

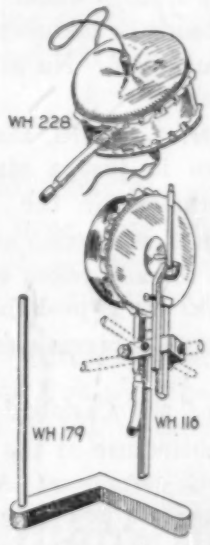

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action compared favorably with the ones from George Washington, showing that there was no difference in the races so far as this reaction is concerned.

The reaction of the taxi drivers was more prompt than that of the non-professional drivers, indicating either that drivers can be trained to respond more quickly or that those with a quick reaction seek and are selected for such positions as taxi drivers. One of the men, who had been driving for fifteen years without an accident, showed a reaction of one third of a second.

These tests were carried on in four speeds: 10, 15, 20 and 30 miles an hour. At a speed of 20 miles an hour with a reaction of one half second the car would go only fifteen feet before it began to stop. With the reaction one and one half seconds the car would be run 45 feet before it began to stop. The rate of speed does not affect the response in any way.

To eliminate drivers with a very slow reaction is the object of these tests. It is expected that they will be used in hiring drivers for the government service, and in the cities requiring a driving test for a license. This is one of a number of tests which are being prepared for selecting chauffeurs.

CAVERNS IN THE GUADALUPE MOUNTAINS

Science Service

AN underworld wonderland surpassing in size, sublimity and beauty anything of the kind hitherto known, such is the report of Dr. Willis T. Lee who has just returned to Washington after a summer spent in surveying and mapping a portion of the caverns which run under the Guadalupe Mountains near Carlsbad, New Mexico.

Dr. Lee and his associates, working under the auspices of the National Geographic Society, traced the ramifications of the main cavern, an underground avenue about a half mile wide, for two miles under the mountains. How much further it extends is unknown. A great number of smaller avenues branch off. No attempt was made to follow these.

There is every indication, Dr. Lee said, that the discovery of the Carlsbad Cavern is just a start of the wonders which further exploration of the Guadalupe mountain region in southeastern New Mexico and western Texas will disclose. Texas has already taken steps to set aside her section as a state park. It is probable that the mountains are honeycombed with subterranean recesses, Dr. Lee said.

The most striking feature of the Carlsbad Cavern is the extreme delicacy of the architecture of the stalactites and stalagmites in the mammoth chambers. All sorts of fantastic, beautiful designs are worked into the onyx marble.

Dr. Lee found the caverns of Guadalupe Mountains the home of a prehistoric civilization. Two skeletons have been sent to the Smithsonian Institution for identification. Other skeletons, buried in baskets, were found on shelves in the walls. The people who inhabited the caves are believed to have been close relatives of the basket-weaving people further west. The caverns are a geological and biological treasure house. There are literally millions of bats, blind crickets and worms and spiders of hitherto unknown species.

Entrance to the cavern now is very difficult. It is necessary to climb 1,000 feet up a mountainside and then go down through a hole in the roof in a guano bucket for 170 feet. A walk of about two miles is then necessary over very difficult flooring before the end of the main cavern is reached. The avenue leads downward through great chamber after chamber until one is 800 feet below the surface of the earth outside. At this point the avenue drops off abruptly 90 feet. This has to be negotiated with a wire ladder. Mr. Lee explored a series of basement chambers never before seen by human eye. The cavern is in dense darkness. The temperature remains all the time at 56 degrees Fahrenheit.

ITEMS

(Science Service)

LAND near the recently discovered Indian rock sculptures or petroglyphs has been offered to the Dominion government by W. F. Islip as a free gift. It is hoped that this gift will serve as a stimulus toward the acquisition of the near-by lands on which the old sculptures are situated, and that all can be consolidated into a new national park for the pleasure of tourists and the preservation of the old carvings.

ELEVEN varieties of chestnuts, secured from the Yunnan Province of southwestern China, are now under cultivation by the Bureau of Plant Industry of the Department of Agriculture. It is hoped to secure from these at least one type that will resist the blight which has ruined so much of the native chestnut crop. The trees as yet are only in the seedling stage. Among them is one which, in Yunnan, produces nuts nearly twice the size of the common American variety. This tree is described as suitable for orchard culture. It grows wild at an altitude of about 8,000 feet.

NEW sources of wealth for the American farmer may be found in the millions of tons of corn cobs now wasted annually in the middle west. Department of Agriculture chemists during the past six years have discovered new values in this neglected material and means for extracting them. Here are some of the new possibilities: Adhesive material, obtained by cooking cobs for a few minutes under pressure in superheated water, can be used for any purpose where a high-grade paste is not essential. A special use proposed for them is in the manufacture of coal briquettes from the finer sizes of anthracite. Furfural, an aromatic liquid about one sixth heavier than water, which can be made to replace formaldehyde in many fields, can be obtained from the cobs by digesting them for about two hours with steam and a very little sulphuric acid under a pressure of 135 pounds per square inch. Other products that can be obtained from corn cobs are oxalic acid, acetic acid, wood alcohol, charcoal, pitch, tar, incense and oils.

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SCIENCE NEWS

OZONE

Science Service

OBSERVATIONS on the screen of ozone, which exists some twenty miles up in our air and blocks radiations of certain wave lengths to or from the earth, were made for the first time in America at Mount Wilson Observatory by Dr. C. G. Abbot, of the Smithsonian Institution, this summer. Dr. Abbot has just returned to Washington, having secured data that may prove of importance to astrophysicists and may also throw much light on world weather changes.

The amount of ozone in our atmosphere is very small, but that small amount is very important. Although if the layer of ozone which exists some fifteen or twenty miles up were placed under atmospheric pressure at the surface of the earth, it would be no thicker than the little finger on a man's hand, yet this scant amount of ozone serves as a screen which blocks off much of the important invisible radiation coming from the sun and stars to the earth or going outward from the earth.

All the shorter wave lengths of the ultra-violet at one end of the spectrum and some of the infra-red or heat rays, at the other end, are shut off by the ozone in much the same fashion that our ordinary window glass shuts out the longer of the ultra-violet rays which are so beneficial to health.

Many of the stars have their chief energy spectrum in the shorter portions of the ultra-violet, so that this screen shuts off observation of these important sections of their invisible light. Heat rays from the earth which are intermediate between light and radio waves are also stopped from radiating into space by this same gaseous screen.

Dr. Abbot's observations were made for the purpose of determining whether or not the amount of ozone in the upper air varies with variations in the earth's heat and with radiations from the sun. The ozone is produced from oxygen in the air by the action of the sun's rays which have a wave length of less than 2,000. Ozone is destroyed by the sun's rays of wave lengths between 2,000 and 3,000.

The amount of this gas in the air, acting as a screen to hold in the earth's heat rays or shut out the ultra-violet rays from the sun at any time, represents a balance between the ozone productive and destructive rays in sunlight.

Dr. Abbot, in discussing his observations, compared these forms of radiations to two men carrying sand to and from a sand pile representing the amount of ozone in the air. If one man carries the sand away faster than the other adds it to the pile, the size of the pile will diminish, while if the man carrying sand to the pile gains on the one carrying it away, the pile will increase in size. Dr. Abbot suspected that some such variation takes place in the amount of ozone in our air.

If there is less at some times than others, obviously at such times the ozone screen will be less effective in preventing heat from radiating away from the earth and so influence climate. The pioneer in these ozone observations was Dr. Fabry, of Marseilles, France, now lecturing at the Massachusetts Institute of Technology.

TRANSPLANTED EYES

Science Service

How eyes of rats, cut out of their sockets and then replanted, recover a considerable degree of their normal structure and function is explained by Dr. Theodore Koppanyi, of Budapest, working in the physiological laboratories of the University of Chicago under Professor A. J. Carlson.

Controversy has been aroused by the work of Dr. Koppanyi, for the problem is recognized by scientists as an important one, with significance for the future of surgery.

Both Dr. Koppanyi and Professor Carlson, who has supervised his work, are cautious in their statements; but they point out that two undoubted results have been accomplished.

In the first place, in at least two of the cases they had under experiment, new nervous tissue grew from the cut end of the optic nerve in the eye socket, penetrated the eyeball, and established good anatomical connections, closely resembling the structures to be found in normal eyes. In the second place, when these rats were tested, the transplanted eyes reacted in a normal manner to light. The eyes would move, and the pupils contract, when light was thrown upon them. Blind eyes, with the optic nerve severed or destroyed by disease, do not react in this way.

Dr. Koppanyi related experiments he performed with the rats, to test their power of sight. Normal rats go away from strong light, while blind rats do not react to light at all. Blind rats placed in a box with a partition, making one side dark, were unable to discriminate between the light and the dark chambers. They walked around in either compartment indifferently. Normal rats remained less than a quarter of a minute in the light before passing through to the dark compartment. Three rats with transplanted eyes behaved in this test like normal rats.

Rats were also tested by placing them on a platform at an elevation of about a foot above the laboratory table. Blind rats do not jump, but sometimes crawl down from the platform clinging to the iron rod on which the platform rests, probably guided by the sense of touch. Normal rats and the three spotted rats with transplanted eyes jumped down from the platform. When the platform was raised to a greater height the rats with transplanted eyes showed some hesitation about jumping, as though they could see the height and appreciate the risk.

Having succeeded in these preliminary experiments with rats, Dr. Koppanyi is now beginning work on animals with larger eyeballs, using dogs at first, and planning to work on monkeys later on.

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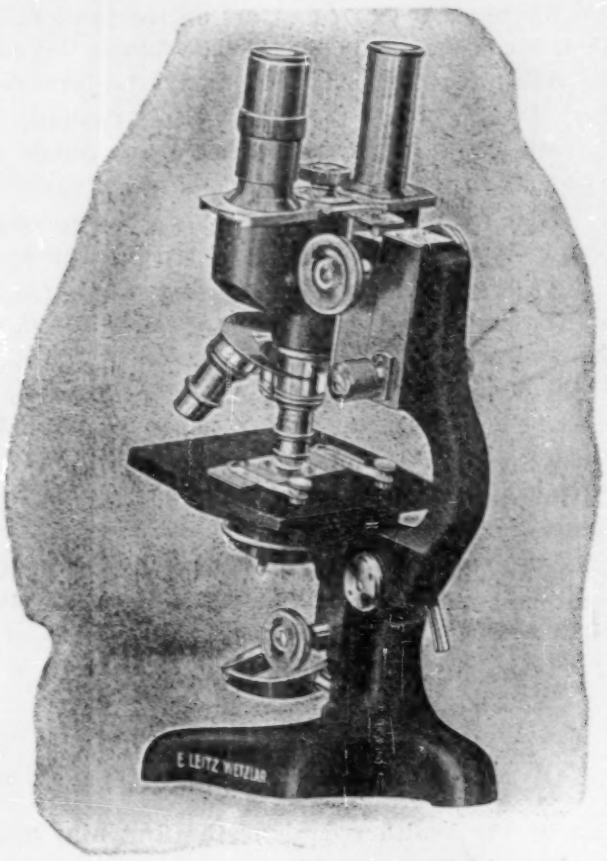

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Professor Carlson stated that he believed Dr. Koppanyi succeeded where other experimenters on the same subject had failed, because of two things. The first is the quickness and skill with which Dr. Koppanyi performed the operation. Drying out of the tissues, and especially bacterial infection, which are almost certain to follow even short exposures to the air, greatly increase the chances of failure. Even with the best of methods one success in ten attempts is counted a very good score. The second item in the success of the present experiments is the fact that Dr. Koppanyi sewed the eyelids of his subjects shut until the wounds of the operation healed up, thus preventing the rats from rolling their eyes about in the sockets and increasing the difficulty of reestablishing connections.

Dr. Carlson warned against too easy credence of stories that similar operations have been performed on human beings, and stated that only after many years of cautious experiment and much improvement in methods would it be justifiable to attempt surgical transplantation of the eyeball.

THE DEATH RATE

Science Service

JUDGED by the health record of the first nine months of 1924, it is highly probable that the death rate for the year, as a whole, will be considerably lower than for any prior year. This is indicated by the mortality experience of the more than 15,000,000 industrial policyholders of the Metropolitan Life Insurance Company.

Among the white policy holders the death rate for all causes combined was but 8.2 per 1,000, which may be compared with 8.8 for the corresponding period of 1923, 8.4 in 1922 and 8.2 in 1921. The 1924 figure, however, reflects an even more favorable condition than did the identical rate recorded at this time in 1921. The reason is that the 1924 rate includes figures on very young lives, among whom the death rate is higher than at any other age, and the 1921 rate does not. This year, therefore, stands out as the most favorable in the history of the industrial populations of the United States and Canada.

The experience among the colored population has not been so favorable, as this year's death rate was 15 per 1,000, which is identical with that in 1923 and considerably higher than in either 1922 or 1921.

The tuberculosis death rate will decline to a new minimum in 1924. A sufficiently large drop was recorded during the first nine months of the year to assure this. The decline has been much greater, however, among white than among colored persons. Among other favorable developments are a further decline in the mortality from typhoid fever and a pronounced drop in the death rate among white women from conditions incidental to pregnancy and childbirth. For the latter the figures for colored women show not only a less favorable record, but an actual increase as compared with this time last year.

There were 342 deaths from alcoholism with a death rate of 2.9 per 100,000. This compares with 323 deaths during the same months of 1923; but these 323 deaths were equivalent to a rate of 3.0 per 100,000. It is now fairly well assured that there will be no rise in the death rate from alcoholism this year as compared with last, and that for the present, at least, the peak in the rise which has been observed since 1920 has been reached. Cirrhosis of the liver, which is closely associated with alcoholism, caused 673 deaths as compared with 630 during the first nine months of last year. The actual death rate, however, runs a trifle lower this year. Only 13 deaths from wood and denatured alcohol poisoning were recorded as compared with 22 during the corresponding period of 1923.

The record for violent deaths shows fewer suicides and fewer fatal accidents among both the white and colored population. The homicide situation has improved among the whites, but among colored persons the record is bad with the rate much higher than for the first nine months of either 1923 or 1922. There have been more accidental drownings and more automobile fatalities this year than last.

PNEUMONIC PLAGUE

Science Service

THE only preventive of the plague, a virulent pneumonia, which has broken out in Los Angeles, is the complete isolation of the patient.

"Careless disposal of the discharges of the patient is the main way of spreading the disease," according to Dr. M. J. White, acting surgeon general of the Public Health Service.

The people infected with the disease in the present outbreak have been Mexican natives of Los Angeles. They were ranch workers and doubtless were infected by ground squirrels. Unlike the bubonic plague, it is not spread by the bite of animals, but through droplets of sputum given off in the air by the patient. It is almost impossible to detect the difference between it and broncho pneumonia in the early stages, except that it is more virulent from the first. An examination of the sputum of the patient will show the presence of the germs.

Dr. G. W. McCoy, director of the Hygienic Laboratory, U. S. Public Health Service, states that the disease must have spread from the ground squirrels in California, since no case of the plague has been recorded in Mexico for the last two years.

The pneumonic plague is a native of Manchuria and other northern climates. The last great outbreak occurred in 1911 when over 50,000 people died in a few weeks. The first known case of pneumonic plague came to the western hemisphere in 1899 from Africa.

In 1919 fourteen cases were recorded in different parts of California. Ground squirrels were examined and found to be infected with the disease. The death rate in this slight epidemic was 100 per cent. It was not recognized definitely until the last case where an autopsy proved it to be plague and not pneumonia. It can never be particularly violent in California as the germs need a cold, damp atmosphere to thrive. Under favorable conditions they can lie dormant for years and still spread the plague. It is probable that it was the pneumonic rather

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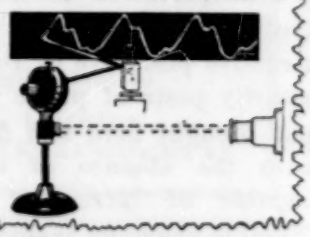

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than the bubonic plague that swept through England and France in the Middle Ages.

Two specialists in contagious diseases, Dr. J. C. Berry and Dr. M. E. Wayson, have been sent out to the coast by the U. S. Public Health Service to study the conditions leading up to the plague. The situation in California is not alarming to any except the ground squirrels as a war of extermination is being waged against them. Every precaution is being taken to prevent new cases. Rats are also suffering in the war. They have been in bad odor as carriers of plague for centuries. The same quarantine precautions are being observed as in diphtheria.

The germ was discovered and isolated by The Royal Academy of Science of Austria in 1898. The germs were brought over from India and Dr. Muller was put in charge of the experimental work. The earliest victim of the plague in Europe was a man named Barisch, who was detailed to watch the animals used in the experiment. Due to carelessness, he became infected with the disease and died. This definitely established the fact that pneumonic plague was caused by a plague germ, bacillus pestis. The people attending his case also died, proving the infectious quality, high fatality and difficulty of diagnosis of this disease, as it was not recognized until he had been ill three days.

Complete extermination of the rats in Los Angeles may be necessary before the pneumonic plague can be stopped. Ground squirrels may have spread the disease to the rats of the city. So far the cases have been confined to the Mexican quarter and to the people who have visited their sick friends. In this case only the most extreme quarantine will have any effect.

A plague serum, rather like the anti-toxin used in diphtheria, has been sent out to the coast by a drug company in Philadelphia. This is purely an experiment, as it has never been tried before in the treating of pneumonic plague. No alarm is shown by the U. S. Public Health Service over the report of a case of bubonic plague in New Orleans. The plague was brought over by a Belgian sailor on a Greek ship from Algeria. The case was diagnosed upon his arrival and all precautions were taken. Since the plague is spread by the bite of a rat flea the ship, *Atlanticos*, has been entirely cleared of rats and has been disinfected.

About a month ago a case of yellow fever was reported in New Orleans without causing a ripple of interest in the medical profession. It was impossible for that case to spread because it was so late in the season that mosquitoes which act as the carrier were dead. In the second place, the case was fully developed and a yellow fever patient can not infect the carrier after the first seventy-two hours of the development of the case.

LOSSES CAUSED BY INSECTS

Science Service

LOSSES equal to $20.00 a year for every man, woman and child in the United States are caused by insects, and the insects are still on the increase, Professor J. J. Davis, of Purdue University, says in a report to the Indiana Academy of Science.

The greater abundance of insects now than formerly was explained as due to civilization having brought about unnatural conditions which have interfered with the natural balance among plants and animals. Among the principal causes which have produced this interference, Professor Davis mentioned the extensive and continuous cultivation of the same or related crops, which is favorable to insect reproduction by offering unlimited food supplies continuously year after year. Corn-root aphis and corn-root worm, for instance, become more severe when corn follows corn.

Another factor, he pointed out, has been the eradication or reduced supply of the native plants upon which the insects formerly lived. Curculio existed only on wild fruits before cultivated varieties were introduced, and the rose-root worm, which now attacks roses in greenhouses, at one time only attacked wild species.

Transportation has also played an important part in the spread of insects, and more than half of our destructive pests are of foreign origin. They are not necessarily pests of prime importance in their native home, but brought here and finding favorable breeding places with the absence of their natural enemies, they are capable of increasing with scarcely any restriction. Notable examples include the Hessian fly, San José scale, Oriental peach moth, currant worm, cabbage maggot, cabbage worm, wheat midge, European corn borer, gypsy and browntail moths, Japanese beetle, cotton boll weevil, pink bollworm and elm leaf beetle.

Even within our own country transportation has had a marked influence on the spread of insect pests. The San José scale, first introduced into America at San José, California, from China, was carried in shipments of nursery stock across the entire continent to New Jersey, from which place it was soon distributed to many other sections of the country. Increase in population, reduction of forests and hunting have also helped the insects by reducing the number of birds and animals which feed upon them.

ITEMS

Science Service

A RACE between archeologist and engineer is in progress near Muscle Shoals, where Gerard Fowke, of the Bureau of American Ethnology, of the Smithsonian Institution, is rushing the excavation of prehistoric Indian mounds soon to be covered by water backed up by Wilson Dam. The party of scientists working at the mouth of Town Creek on the Tennessee River has uncovered thousands of implements from the kitchen middens or refuse heaps of ancient Indian villages. Horn instruments were found showing that the matured horn of the southern deer was used in making arrow heads and spear points. It was used in pressing up the edge of freshly splintered flint and in shaping it into arrow heads and spear points. Flint is easily worked with this horn and the bevel edge, which give the rifle twist to the arrows, was made by these horn instruments. The mound is composed largely of periwinkle shells and thousands of bone-picks used to extract the meat of this snail from the shell have been discovered. Some of these picks have a perforated end for hanging, but the majority of them are pointed at both ends.

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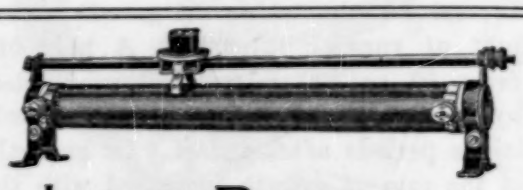

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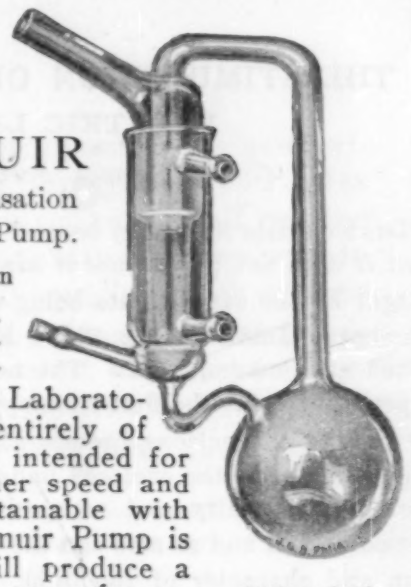

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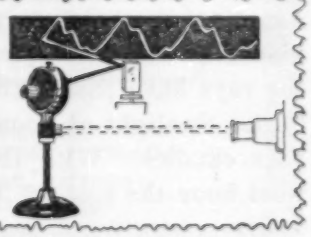

SCIENCE NEWS

THE STIMULATION OF GROWTH BY ELECTRIC LIGHT

Science Service

THAT electric light may be used in place of sunlight and that it does not pay to use it are two of the first lessons taught by the experiments being carried on at the Boyce Thompson Institute for Plant Research recently established at Yonkers, N. Y. The new laboratories give the experimenter for the first time opportunity to change one by one all the various factors affecting plant growth in the open, for in the enclosed underground rooms the temperature, humidity and composition of the air can be varied at will and so also can the amount, intensity, duration and character of the light.

In the experiments on the optimum length of illumination a variety of plants were exposed to electric light for periods of 5, 7, 9, 17, 19 and 24 hours. The dark periods were secured by wheeling the carts bearing the plants into a constant dark room having the same conditions as the light room. Remarkable differences appeared in the rate of growth of the plants and the age and stature of the plants at the time of flowering with the different lengths of day.

Varieties of tomato, snapdragon, sunflower, coleus, radish, lettuce, clover, geranium and chrysanthemum bloom much earlier in constant light than in shorter daily illumination. Buckwheat, aster and soy beans bloom much later in constant light than in shorter days. Salvia, cosmos and four o'clock failed to bloom at all in constant light.

Tomato grew faster and made better plants as the daily illumination increased from five to seventeen hours. Nineteen hours daily illumination was injurious to the tomato and constant illumination finally killed it. Some other plants were injured by nineteen hours illumination and constant illumination. With some plants then there seems to be a limit to the possibility of forcing by lengthening the day. It is not known whether this is due to the need of daily rest from growing activity, or to some other cause.

But the complete replacement of natural by artificial light shows no prospect of being profitable, according to Dr. William Crocker, director of the institute, who gives out the following figures as to the costs of illuminating the constant condition room:

"On the matter of the economic possibility of using artificial light for growing plants I will mention the costs of illuminating our constant condition light room. This room is eleven feet by eleven feet and is illuminated by twenty-four 1,000 watt tungsten lights. They give about 500 foot candles in the growing room after the rays have passed through the water screen to remove heat. Sunlight at noonday in June gives 4,000 to 10,000 foot candles. With the current at 4½ cents per kilowatt hour the cost of lighting this room is $1.12½ cents per hour; $27.00 per day; or $2,430 for 90 days. It is evident that one would have to grow something of the order of value of pearls to make the use of this house commercially profitable. The reasons for this are clear. The tungsten lamps convert only seven per cent. of the electrical current used by them into light. The sun is much more efficient as a light source. Thirty-seven per cent. of the energy value of the sun's rays reaching the earth are light rays. The plant uses only the energy of the light rays for making its foods and probably the average plant in this room stores no more than 10 per cent. of the light energy falling upon it in the form of carbohydrates and other organic foods. This means that less than one per cent. of the energy paid for as electrical current is recovered by the plant. Even a portion of this is used by the plant in its own respiration.

"The plant is a very inefficient machine for the transformation and storage of energy. The only reason man can afford to use it at all is because the sunlight from which it stores the energy in nature, like salvation, is free. It might be added, however, that in spite of this inefficiency man can not only afford but must use it, for up to date the plant alone can synthesize many organic materials necessary to life.

"Now what is the excuse for experimenting with the growth of plants under artificial light, if the plant is such an inefficient machine for the conversion and storage of energy? The institute has a very good excuse. It is trying to establish the laws of plant development. The only way to establish such laws is by growing plants under controlled conditions. Artificial light makes accurate control possible. I would not imply that artificial illumination has no possibility of profitable use in the growth of plants commercially. I do mean to imply that with the present inefficiency of tungsten lights and the present price of electrical current, we can not afford to grow the bulk of the plant (and bulk is a measure of the amount of energy stored) with artificial light even if the plant could be sold at a fancy price."

In the meeting of the Illuminating Engineering Society held at the institute, Victor A. Tiedjens reported the results of his work on stimulating the growth of lettuce by electric light of varying intensity. A pair of lamps, ranging from 50 to 300 watts, was suspended about five feet over each plot of eight feet square and turned on for various periods after sunset. In general, it was found that the rate of growth increased with the intensity of the illumination.

"The length of the growing period, from seedling to head formation and seed production, was shortened by two and four weeks respectively for the higher intensities, but the growth was not always beneficial to good head formation. The seed stalk was started before a good marketable head was formed in the varieties commonly grown by market gardeners."

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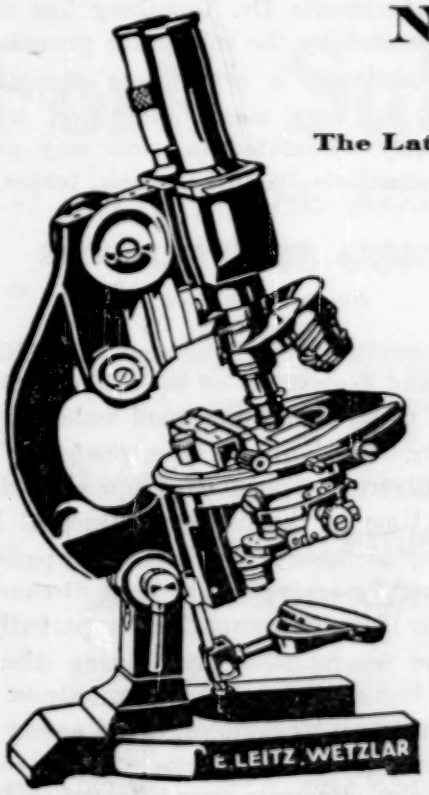

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ETHYL GASOLINE

Science Service

WHEN tetraethyl lead is added to gasoline in the usual commercial concentration of one part in a thousand automobile exhaust gases result that have produced no ill effects on animals under study by the U. S. Bureau of Mines at Pittsburgh.

The government experts point out that the industrial hazard during the manufacture of the anti-knock compound and the possible danger from its use in automobiles are quite different due to the low concentrations in the exhaust gases.

To test the possible hazard due to the exhaust gases from automobiles using ethyl gasoline as ordinarily sold, pigeons, guinea pigs, rabbits, dogs and monkeys, over 100 animals in all, were exposed to a definite concentration of exhaust gas from an engine using ethyl gasoline. The concentration of exhaust gas in air used was that which, when coming from the average automobile, would be four parts carbon monoxide in ten thousand parts of air; a concentration allowable for but a period of one hour exposure from the standpoint of carbon monoxide, and exceeding that known to exist in ordinary traffic of a city street.

Two groups of animals were exposed for daily periods of three and six hours, respectively, and the third group not exposed. The animals were observed throughout the test period of eight months for symptoms of lead poisoning, as colic, paralysis, loss of appetite and loss of weight, and there was no indication of lead poisoning. At various times animals were killed and the entire tissues examined for effects of lead and analyzed for stored-up lead.

Observations made on man showed that most of the lead in exhaust gases coming from ethyl gasoline when inhaled is again exhaled. The investigation indicated the seeming remoteness of any danger of undue lead accumulation in the streets through the discharging of scale from automobile motors.

The opinion of Dr. Yandell Henderson, of Yale University, as reported to *Science Service*, is as follows:

"The amount of tetraethyl lead added to gasoline is small yet if all cars used it a person on Fifth Avenue, New York, in eight hours would inhale about the minimum amount sometimes inducing symptoms of lead poisoning. I pointed this out to representatives of General Motors two years ago. They claim that most of the lead is accumulated in the muffler of a car and is not discharged. Obviously, however, when a cylinder misfires, as in cars in repair shops and garages, while warming up and even on streets, undecomposed tetraethyl lead may be discharged.

"It is reported that the method of dispensing tetraethyl lead to the public is to attach a small tank of the highly concentrated substance to the gasoline pumps at roadside filling stations. A small amount is added to each gallon of gasoline and it is pumped into the tank of a car. A warning accompanies each tank but the names reported as commonly used for the substance such as ethyl gas and ethyl alcohol are not indicative of an acute poison.

"Lead by preventing premature explosions increases efficiency. It makes possible engines using much higher compression than at present. The introduction of cars with such engines would put all present automobiles out of date, so that the market could be resold. We should all want one of the new ones.

"I have been trying for many months past to warn the health authorities and the general public of this new hazard. When the outbreak of poisoning at Bayway was reported in the newspapers and when the officials of the company adopted a policy of secrecy I stated that the mysterious insanity gas is tetraethyl lead."

TUBERCULOSIS AND DIABETES

Science Service

THE curious fact that diabetes can sometimes be cured by tuberculosis has led a prominent Swedish specialist, Dr. Erik Lundberg, to researches and discoveries which promise to have important effect on the future treatment of both diseases. This is of special interest in connection with the widely-heralded use of insulin in the relief of diabetes. Proceeding on the theory that in the case of consumptive patients insulin, or something similar, is secreted outside of the pancreatic gland, Dr. Lundberg experimented with mice which he infected with tuberculosis and then dosed with insulin. He succeeded in producing insulin poisoning which led to instant death, except where he made injections of grape-sugar along with the insulin. He found that the injection of about one half cubic centimeter of a solution of 10 per cent. grape-sugar resulted in immediate recovery from the insulin poisoning.

From these experiments Dr. Lundberg has concluded that insulin is secreted by the tubercular granular tissue, and that this substance is everywhere present in the human organism in very small quantities, where the secretion is greatly stimulated in some way under the influence of tuberculosis bacilli or their toxins.

MALARIA AND PARALYSIS

Science Service

REMARKABLE results in the treatment of a hitherto incurable disease and discoveries of the highest importance for the conquest of another widespread malady have been announced by Dr. Warrington Yorke, professor of parasitology of the Liverpool School of Tropical Medicine.

For the first time in the history of mental hospitals there and in other sections of Great Britain, patients suffering from general paralysis have been discharged and returned to their former occupations apparently cured. These cures were accomplished by fighting disease with disease, malaria being used to conquer paralysis.

The malaria-carrying mosquitoes, dread enemy of civilization, were enlisted by Dr. Yorke and his co-workers as allies in the fight. Patients were infected with malaria by the bites of these mosquitoes and then the malaria was conquered by the use of quinine.

Out of 84 patients infected, 14 died, 20 showed no change, 10 were improved physically but not mentally, 17 showed definite mental and physical improvement, and 23

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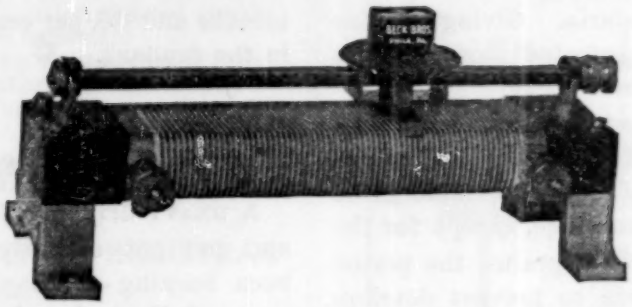

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BUFFALO, N. Y.

were so much improved that they were discharged from the hospitals.

In treating the patients by this method, new and striking information was obtained about malaria itself. The experiments of the Liverpool School indicate that quinine will not protect persons from malaria. Giving quinine before a person is bitten by an infected mosquito was found to be useless.

In order to prevent malaria from developing, quinine must be administered for at least ten days after the mosquito bites. The size of the daily dose of quinine given was discovered to have but little influence, except for the fact that with very large doses of 30 grains, the period for which the drug had to be given to prevent development of the infection was slightly shortened.

According to Dr. Yorke, the quinine invariably destroys large numbers but not all the malaria parasites in the blood of an infected patient and sets free a soluble substance which stimulates the tissues of the patient to form an immune-body. This immune-body in turn destroys the remaining parasites, thus resulting in the cure of the patient. When for any reason, an insufficient amount of the immune-body is produced, the infection is not sterilized and a relapse occurs.

RIPENING CANDY

Science Service

CANDY filling may be kept soft for months inside its chocolate coating by a process discovered by H. S. Paine and J. Hamilton, of the U. S. Bureau of Chemistry. They have found that the addition of invertase extract makes unnecessary the ripening process which causes delays in candy manufacture.

Invertase is an enzyme found in nature that has the power of changing cane sugar back to simple sugar like dextrose. While fondant seems to be a solid it is really composed of microscopic bits of sugar held together by a film of syrup. It is about the consistency of putty and has a number of its physical characteristics. When fondant is stretched out it looks dry and stiff. When it is worked together between the fingers it becomes oily and moist.

The action of the invertase dissolves a number of the sugar crystals making the syrup film constant around them. This assures the creamy center which is so much to be desired.

Cream of tartar added to the candy would give the same creamy filling but the addition of the acid spoils the taste, and does not do away with the process of ripening, however, as invertase does.

According to the old rule for fondant, handed down from master to apprentice, fondant had to be cooked slowly, allowed to cool thoroughly, beaten with a wooden paddle. Then it was put into stone jars and allowed to ripen for several days. After this it was taken out, melted and poured into starch molds. It was allowed to ripen in the molds for several days before it was dipped into chocolate. The chocolate coating acts as a protection against drying. Inside this air proof case inversion takes place to a slight degree, that is, the sugar particles dissolve somewhat in the syrup.

By the addition of invertase when the flavoring is added the ripening process is not necessary. The fondant is cooked, beaten with a wooden paddle, remelted, poured into molds, and dipped in chocolate all in the same day. Chocolates treated in this way have been tested after six months and 6.8 per cent. of water has been found present in the fondant.

ITEMS

Science Service

A HEAVY dripping fog rolled in from the Pacific ocean and put out effectively a fierce forest fire which had been burning for days in the Olympic peninsula southwest of Port Angeles, Wash. This is the only time recorded in northwest forestry of the occurrence of such a phenomenon. With no indication of rain and lacking water with which to fight the advance of the flaming menace, foresters watched the fire making progress toward the town of Quilcene, beyond which lay valuable tracts of big trees, when suddenly the wet fog descended. Like a huge gray cloud it settled down upon the forest enshrouding everything. The fire fighters fled in terror lest they become bewildered and lost on the mountain sides. Soon the pungent smell of cedar and hemlock smoke disappeared and by mid-afternoon when the fog lifted there remained but a few smoking dead logs, while all about the charred trunks of former merchantable trees dripped with water from the providential fire extinguisher.

AN unknown object has been sighted in the heavens. What may be a new comet or a new minor planet or asteroid has been discovered by the astronomer Dr. Baade at the Hamburg Observatory, at Bergedorf, Germany, according to a cablegram received at the Harvard College Observatory. It is a comparatively faint object and visible only in large telescopes. The discovery was made on October 23, when the astronomical constants of the newly discovered object were reported as follows: Right ascension 21 hours, 5 minutes and 16 seconds, declination north 15 degrees, 28 minutes, magnitude 10. The astronomical newcomer will probably soon be detected by American telescopes near the constellations of Cygnus, the Northern Cross and Aquila, now visible in the northwestern part of the evening sky. The object is reported to be moving at a fairly rapid rate.

A FLOWER species found in early American colonial days and not seen again for 175 years has been rediscovered at Upper Marlboro, Md., near Washington, by two Washington naturalists, Dr. E. T. Wherry, of the U. S. Department of Agriculture, and Dr. J. E. Benedict, of the U. S. National Museum. The plant is the Pink Turtlehead, known to botanists as *Chelone obliqua*. It grows in wet ground, reaching a height of two and a half or three feet, and bears large, handsome pink flowers of an odd shape that have suggested its English name. It was first found in the early eighteenth century by John Clayton, a noted English-American botanist, and sent by him to Linnaeus, the great Swedish scientist who founded modern botany. Since that time it has not been seen again until its recent rediscovery.

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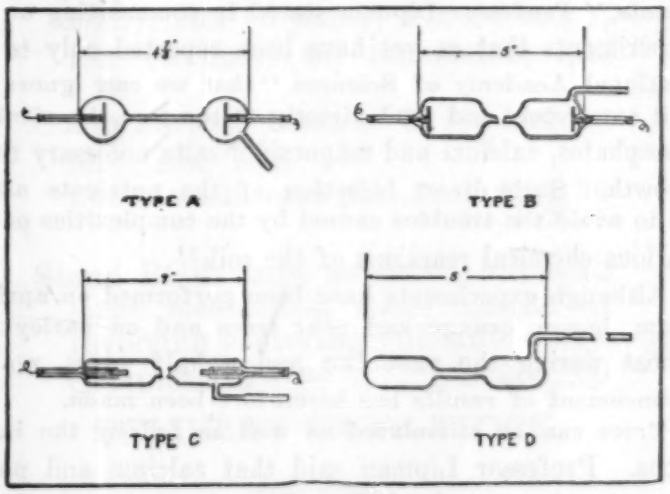

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SCIENCE NEWS

PLANT INJECTIONS

Science Service

HYPODERMIC injections are being used to feed and cure hungry and ailing fruit trees located at the University of California, at Berkeley, California.

Dr. C. B. Lipman wields a glorified hypodermic needle-like apparatus with which curative solutions and food are placed directly into the circulation of the growing plant. The natural method of providing the tree with its sustenance through the soil by means of fertilizers has in a large measure been superseded by direct feeding and medical treatment.

Primarily the new method is being used as a first aid to sick citrus trees. Orange and lemon orchards are sometimes attacked by a disease called chlorosis which causes the leaves to become yellow and the trees to cease bearing fruit. Professor Lipman and his associates attended some trees that had been in this nearly dormant condition for three years.

They bored holes into their trunks to about three-quarters the diameter. Then glass tubes were inserted and sealed tightly with a special wax. Reservoirs containing a solution of ferrous sulphate were attached and the trees were allowed to drink up the solution. In three weeks the yellow leaves had been replaced by green ones and the trees had taken a new lease on life. They now give signs of fruiting.

Citrus trees are heavy users of calcium in which some soils are deficient and the University of California scientists have found that injection of calcium nitrate or chloride into their trunks will cure and prevent a harmful mottling of the leaves due to lack of this salt.

"We believe that this ushers in a new era in feeding plants," Professor Lipman stated in commenting on the experiments that as yet have been reported only to the National Academy of Sciences "that we can ignore the soil completely and feed directly to the tree the nitrates, phosphates, calcium and magnesium salts necessary to its growth. Such direct injection of the nutrients allows us to avoid the troubles caused by the complexities of the various chemical reactions of the soil."

Although experiments have been performed on apricot, plum, lemon, orange and pear trees and on barley and wheat during the past two and a half years, no announcement of results has heretofore been made.

Trees can be stimulated as well as fed by the injections. Professor Lipman said that calcium and potassium salts have a stimulating effect when injected. Large quantities of solutions can be absorbed by the trees. One pear tree was persuaded to soak up over 60 quarts of chemicals in 24 hours.

The insect menace is to be combated by the new injection method. Professor Lipman next plans to experiment with solutions of chemicals that are known to be toxic to injurious insects but not harmful to the trees. The trees injected with the poisonous liquid will become poisoned bait to marauding scale insects or other harmful pests and thus will become self-protective.

UNIQUE BIRDS OF CHILE

Science Service

REMARKABLE birds of the Pacific coast of South America, including a wild duck that can not fly, a penguin that makes its nest in the midst of a jungle instead of on a rocky islet where one would expect to find penguins, and gulls that are a menace to sheep, were described before the American Ornithologists' Union meeting at Pittsburgh, by Dr. Frank M. Chapman, of the American Museum. Dr. Chapman has recently returned from a rapid study tour of the waters and coast lands of western South America.

The coast of Chile, he pointed out, is especially well adapted for the study of bird life and other natural history problems. In the first place, the climate ranges all the way from very wet in southern Chile to absolute rainlessness in the nitrate deserts of the north. Then, the sea penetrates deep into the Andes range, and indeed in the southern part actually pierces it in several places, so that products of southern Patagonia can be loaded on ships from the Pacific. These long fjords, as well as Magellan Strait itself, are simply flooded mountain valleys, and the offshore islands are simply isolated peaks and ranges.

In this region, where Darwin spent more than a year when he was on his famous voyage in the *Beagle*, a longer series of studies is planned for the near future.

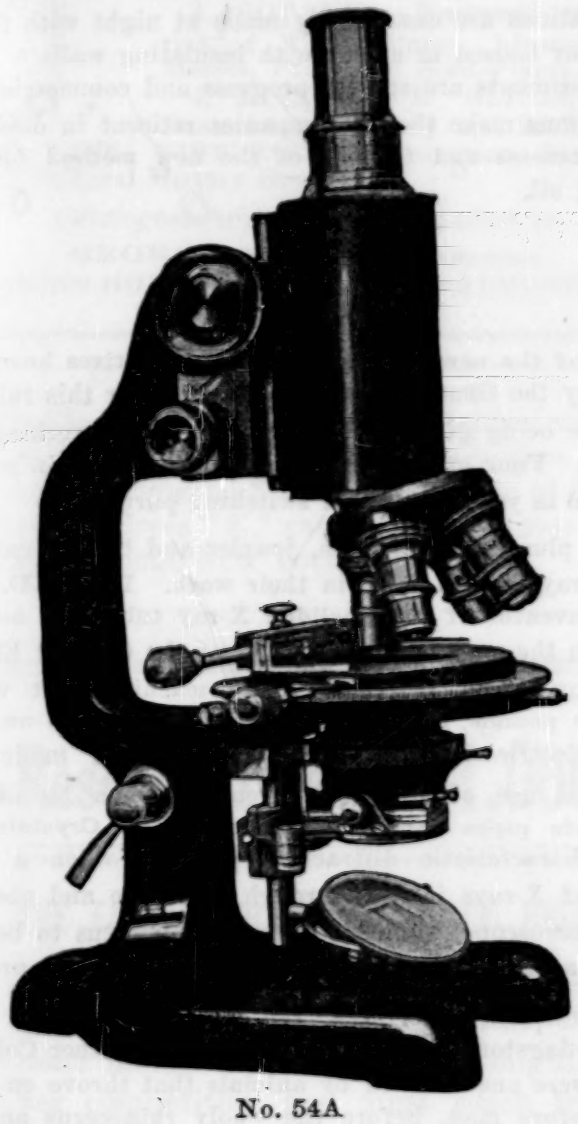
Among the most interesting of the birds studied and photographed by Dr. Chapman was the loggerhead duck, also called the steamer duck, because of its peculiar method of half swimming and half flying. Its body is much too heavy for its short wings, often weighing ten or twelve pounds, and when it beats the air with its wings it rises partly out of the water, like a hydroplane, and thrashes up so much spray that it suggests the action of a sidewheel steamer, whence its name, "steamer duck."

The Chilean penguin is closely related to the penguins of the antarctic regions but instead of living on rocky islands in great rookeries near the shore, builds its nest in almost impenetrable jungles on forested islands. And though the forests are of a semi-temperate zone type, they harbor such birds as parrots and hummingbirds, most unlikely companions for penguins. It was like finding polar bears and elephants together, said Dr. Chapman.

The sheep ranchers of Patagonia are much disturbed over two birds, the speaker continued. One of these is the kelp goose, a large and very beautiful bird, and much devoted to his family. But the goose eats a great deal of grass—six geese as much as one sheep, the ranchers say—and hence is regarded as an enemy. The second bird that is "in bad" with the sheep men is the black-and-white Dominican gull. These birds have thriven marvelously on the offal of packing plants of the region and have become very numerous. But the sheep raisers claim that when their usual bounty of offal runs low the gulls attack and devour young lambs. So geese and gulls are both under the ban in Patagonia.

Bisch

Microscopes



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GRAVITY BALANCE AS A DIVINING ROD FOR OIL

Science Service

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Yet now comes a scientific instrument that promises to be a sort of divining rod for oil. It is the Eotvos Torsion Balance, now being tested by certain progressive oil companies in California as an aid in locating new oil fields.

This instrument was developed over thirty years ago by the great Hungarian physicist Eotvos who found he needed some super-sensitive means of measuring the force of gravity so as to detect its minute variations from place to place. However, it was a great many years later that the first suggestion was made that the balance could be put to practical use and it is only within the past few months that oil companies have become interested in its possibilities.

Essentially the mechanism consists of a light aluminum bar suspended from a fixed point by a fine platinum wire about a yard long. On one end of the bar is fastened a little platinum weight while an equal weight attached to the opposite end hangs down two or three feet below the bar. The weighted bar tends to rotate under the influence of the force of gravity until it comes to a certain position of equilibrium. This position of rest is either read off on the scale provided or in the case of newer models registered photographically. The whole instrument is then turned in another direction, the new position of rest recorded and the process repeated until enough data have been secured to calculate the exact value of the force of gravity at that station. Similar observations are made at other stations judiciously spaced over the area being investigated.

The torsion balance gives no direct indications of the presence of oil-bearing rocks underground. It gives only an accurate picture of the variations of the force of gravity in the locality. It is then up to the oil geologist to use this gravity data to help in working out the location of structures in the underlying rocks which are favorable for oil accumulation. Most of the important oil fields have been found to occur where the underlying strata have been arched upward. Where such conditions exist the older and generally heavier rocks approach nearer the surface and bring about a slight local increase in the force of gravity. It is in this roundabout manner that gravity measurements aid in the search for oil.

In actual practice a lot of troublesome corrections have to be made for the force of gravity is influenced by distance from the equator, elevations above sea level and especially by the proximity of hills and mountains. The Torsion Balance is so sensitive that even the presence of the observer is registered by a deflection of the beam. It bears much the same relation in sensitivity to the delicate balance used in chemical analysis as that instrument does to the railroad scales used for weighing freight cars. Extraordinary precautions have to be taken to prevent disturbances other than those due to gravity. The swinging parts, consisting of wire, beam and weights, are enclosed in a double-walled metal case. Even then, the sun's rays might set up tiny air currents inside which would cause temporary deflections of the beam and so the observations are customarily made at night with the instrument housed in a tent with insulating walls.

Experiments are still in progress and commercial considerations make the oil companies reticent in disclosing the successes and failures of the new method for predicting oil.

ITEMS

Science Service

Six of the new type of electric locomotives have been built by the General Electric Company for this railroad, and are being given a thorough test under working conditions. Four of them are used in regular train service, and two in yard service for switching purposes.

THE plumber, electrician, jeweler and builder can now use X-rays to aid them in their work. Dr. W. D. Coolidge, inventor of the Coolidge X-ray tube, has now devised in the research laboratories of the General Electric Company a new portable X-ray machine that weighs only 30 pounds, and that can be plugged into an ordinary electric light socket. Dr. Coolidge made first practical use of his new invention when he used it to locate pipes in his bathroom floor. Crystals produce characteristic diffraction patterns when a small beam of X-rays is shot through the stone and observed in a fluoroscope, allowing the new apparatus to be used in testing the genuineness of diamonds and other precious stones.

THE flagstone sidewalks of Denver and other Colorado cities were once walked by animals that throve on earth long before man, before the wooly rhinoceros and the saber-toothed tiger, and ages before even the dinosaurs appeared. This is the explanation given by Professor Junius Henderson, of the University of Colorado geology department, for the peculiar track-markings in the sandstone that was quarried and made into the older walls of the city. These animals, he says, were not large, only about the size of a Gila monster, though they were not lizards, but amphibians like the modern salamanders and newts. They walked high on their toes, for there is no sign that their bodies trailed in the soft sand that later was hardened into stone. If they had any tails they carried them high also, for there are no marks of dragging tails. And they were a sober, well-behaved race, for the tracks do not zig-zag, but proceed in orderly straight lines.

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SCIENCE NEWS

THE CHARGE OF THE ELECTRONS

Science Service

DR. A. W. HULL, of the General Electric Company's Research Laboratory, and Dr. N. H. Williams, of the University of Michigan, reported to the American Physical Society meeting at Ann Arbor, on November 29, that they have been successful in listening by radio to movements of electrons, the smallest particles of matter.

Using a vacuum tube radio amplifier, magnifying the sound a hundred thousand fold, the rain-like blows of many electrons on the plate of the tube produced a roar that sounded like Niagara in the distance. The sound is caused by bombardment of the plate by electrons, released from the hot filament. It is these electrons which carry the current and which make the operation of the tube possible. Dr. Hull therefore believes that the noise is a fundamental property of electron emission, a characteristic of the electron. The noise, due to the electrical oscillation, which is set up by the impacts of the individual electrons on the plate, is known as the Schrot effect and was predicted on theoretical grounds by Dr. Schottky, of Berlin.

Listening to the electrons was merely incidental to more technical researches undertaken by Drs. Hull and Williams. They were primarily engaged in measuring the electrical charge on the electron. This was first accomplished with great accuracy by Dr. R. A. Millikan, of the California Institute of Technology, at Pasadena, and winner of the Nobel Prize for physics last year. Drs. Hull and Williams were attempting to obtain the same results by a method differing from that used by Dr. Millikan.

Dr. Millikan's method of measuring the charge of an electron is based on the influence of gravity and of electric charges on minute oil "droplets." These droplets are so small that the effect of gravity causes them to fall only a quarter of an inch in ten seconds—they are about three hundred-thousandths of an inch in diameter and are observed in a powerful beam of light with a small telescope. They are then seen as specks of light against a dark background.

In the formation of these small drops with an atomizer, occasionally one becomes charged by friction; that is, it may carry an additional electron. If then the droplet is between two electrically charged plates it will behave differently from the uncharged particles. Those which are not charged will fall. The charged particles will be attracted to the positive plate. By the use of the proper voltage between the plates, these charged particles can be made to fall more slowly, held stationary, or caused to move upward. If two electrons instead of one are held by the droplet, the effect is doubled.

Drs. Hull and Williams have measured the charge of the electron in a different way, by means of the Schrot effect, and have opened a field for research which promises to add to the knowledge regarding the electron and its properties. Previous attempts were made by German scientists to make the electron audible, and to measure the charge of the electron by this method. Only approximate values were obtained, however. By the procedure used by Drs. Hull and Williams it is possible to obtain values of high accuracy. The measurements thus far made by this method give a value for the charge of the electron within one half per cent. of Dr. Millikan's value. The measurements were made while working with radio frequencies and studying vacuum tubes.

THE MISSING CHEMICAL ELEMENT

Science Service

ELEMENT 61, one of the five missing chemical building blocks of all matter, may soon be discovered. Professor C. J. Lapp, of the University of Iowa, before the recent meeting of the American Physical Society reported the results of his systematic search for this elusive element, which, though not heretofore detected by chemical or physical means, has had many of its properties predicted. Element 61 is known to be a rare earth, in the same class with cerium, whose oxides are used in the manufacture of gas mantles. There is a vacant space in the periodic table of chemical elements between number 60, neodymium, and 62, samarium, waiting to be filled.

One faint clew to missing element 61 has been found by Professor Lapp. By examining some samples of rare earths carefully prepared by his colleague, B. S. Hopkins, he has discovered a single and very faint line in the spectrum produced by X-rays reflected on to a photographic plate from the rare earth sample. This line is not claimed by any other chemical element and corresponds very closely in wave-length to a line predicted on theoretical considerations as belonging to element 61. On this evidence, Professor Lapp believes it likely that element 61 is present in his samples of rare earths in quantities of about 1 part in 2,000 or less.

Even if later research results in the definite identification of element 61 and its chemical isolation, it is doubtful if it will be of any commercial value. Very few of the rare earths are utilized in every-day life, and they are usually so mixed up one with the other that they are only occasionally separated with any degree of purity. The rare earths include such unfamiliar elements as: cerium, praesodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, cacciopeium.

There are now only five missing chemical elements, including number 61. All the rest of the 92 elements, from the lightest, hydrogen, to the heaviest, uranium, have been discovered. Numbers 43, 75, 85 and 87 are among the missing.

Many of the chemical elements have been first discovered in the spectrum and then found and isolated by chemical means. Helium was discovered in the sun in 1868 by lines seen in the spectrum of sunlight, and not until 1895 was it isolated by Sir William Ramsay. The latest conquest of physics and chemistry was the dis-

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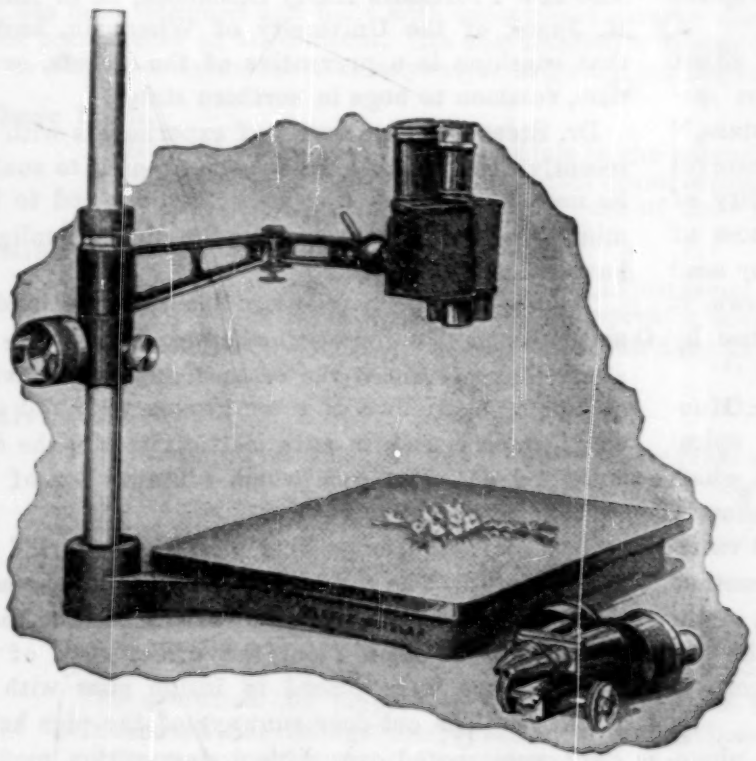

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covery of element 72, hafnium, by the Dutch physicist Coster and the Hungarian chemist Hevesy working in the laboratory of Professor Neils Bohr in Copenhagen. Using first the X-ray spectroscope and then chemical methods, they discovered that hafnium frequently occurs in zirconium minerals and makes up about one two-hundred-thousandths of the earth's crust. It is more plentiful than the well-known metal, tungsten. The periodic table of elements, devised by the Russian chemist, Mendeleeff, in 1869, arranged the elements in logical order and allowed prediction of some of those then missing. Moseley, the young British physicist who was killed early in the world war, was able by applying X-ray spectroscopic methods to arrange the known chemical elements in an orderly series according to their atomic numbers. This classification is more enlightening than the Mendeleeff periodic table and has allowed more precise prediction of the properties of missing elements.

THE SPIRAL NEBULAE

Science Service

DR. EDWIN HUBBLE, of the Mount Wilson Observatory in California, according to an announcement given out by the Carnegie Institution of Washington, has made an advance in our knowledge of the distance of the spiral nebulae.

"The spiral nebulae are much too distant to admit of the use of the simple method of triangulation employed successfully in the case of the nearer stars," Dr. Hubble explains. "There are, however, powerful methods available which depend upon the possibility of determining directly the true or intrinsic brightness of stars from the characteristics of the light which they send to us. If the intrinsic brightness of a star is known, it is a very simple computation to derive its distance by comparison with its apparent brightness in the sky."

One of these methods, and that employed by Dr. Hubble in his investigation of the two brightest spiral nebulae, depends upon the fact that certain stars which vary in light in a definite way are known to show a direct relationship between the period of their light variation and their true or intrinsic brightness. The method has been used successfully by Dr. Harlow Shapley, of the Harvard College Observatory, in his studies of the distances of the globular star clusters and the Magellanic clouds of the southern hemisphere.

The investigations of Dr. Hubble were made photographically with the 60-inch and the 100-inch reflectors of the Mount Wilson Observatory, the extreme faintness of the stars under examination making necessary the use of these great telescopes. The resolving power of these instruments breaks up the outer portions of the nebulae into swarms of stars which may be studied individually and compared with those in our own system. From an investigation of the photographs, 36 variable stars of type referred to, known as Cepheid variables, were discovered in the two spirals, Andromeda and No. 33 of Messier's great catalogue of nebulae. The study of the periods of these stars and the application of the relationship between length of period and intrinsic brightness at once provided the means of determining the distances of these objects.

The results are striking in their confirmation of the view that these spiral nebulae are distant stellar systems. They are found to be about 10 times as far away as the Small Magellanic Cloud, or at a distance of the order of 1,000,000 light-years. This means that light traveling at the rate of 186,000 miles a second has required 1,000,000 years to reach us from these nebulae, and that we are observing them by light which left them in the Pliocene age upon the earth. With a knowledge of the distances of these nebulae, we find for their diameters, 45,000 light-years for the Andromeda Nebula, and 15,000 light-years for Messier 33. These quantities, as well as the masses and densities of the systems, are quite comparable with the corresponding values for our local system of stars, the one in which the earth is but a mere speck.

RHEUMATISM AND SUNLIGHT

Science Service

EVEN pigs need the sun. Recently doctors proved that children who were allowed to play in the sunlight were not troubled with rickets, or malformation of the bones. And now Professors Harry Steenbock, E. S. Hart and J. H. Jones, of the University of Wisconsin, have proved that sunshine is a preventive of the rickets, or rheumatism, common to hogs in northern states.

Dr. Steenbock in a series of experiments with rats had recently demonstrated that foods exposed to sunlight can be used as a cure for rickets. It remained to be determined whether or not exposing the pigs to sunlight would have the same effect.

Twenty-four pigs, reds and blacks, were used for the experiment. To discover whether it was the sunlight alone that prevented the disease they were divided into groups of six. Two of these groups were fed on yellow corn, which is rich in antirachitic vitamin, the other two were fed on white corn which contains less of the antirachitic vitamin.

Two of these groups were placed in "dark" pens and two in light. The "dark" pens could not be considered dark in the ordinary sense of the word, but the pigs in them were shielded from the direct rays of the sun. Both groups were placed in inside pens with out-door runways. The out-door runways of the pigs kept in the dark were roofed over with a composition roofing which kept off the direct rays of the sun.

The range of the experiment was from June to January. The time is important as the intensity of ultraviolet solar radiation varies decidedly with the season of the year. Rickets occur in children most often in the seasons when the sunlight contains less of the ultraviolet rays.

As a criterion of progress the pigs were weighed every two weeks. A great irregularity in growth was shown varying with the reserves of vitamin stored up by the animal from birth. It is impossible to produce rickets in any animal that has been long fed a ration rich in xitamin before the experiment. Dr. Steenbock concludes

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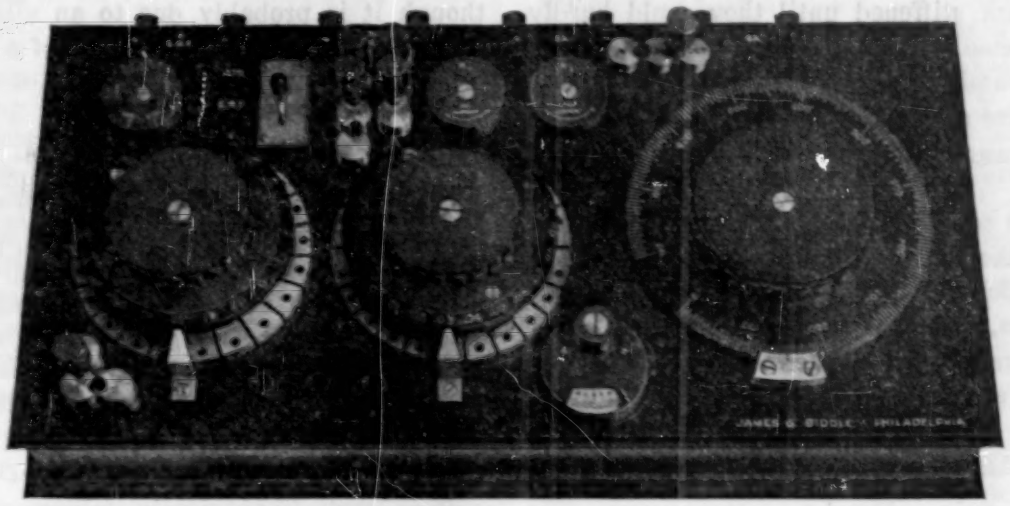

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that ultra-violet light can substitute for the vitamin preventing rickets, but not for the vitamin (A) which promotes growth, and that, in spite of radiation, growth will cease on exhaustion of stored reserves of Vitamin A. The yellow corn group grew better than the one on white corn. In the yellow corn group light was found to be extremely beneficial to the animals. Little by little, the pigs kept in the dark stiffened until they could hardly walk, even with extreme provocation.

On microscopic examination the bones of all pigs that lived in the light were seen to have a more regular structure and better arrangement of tissue than those that lived in the dark.

The experimenters conclude that "light in the absence of a sufficiency of the antirachitic vitamin is an important factor to consider in swine industry. In fact, there remains no question, in view of the conditions under which pigs are generally kept and fed in northern climes, that more attention should be paid to illumination."

EXPERIMENTS ON IMMUNITY

Science Service

A NEW method of combatingdisease germs has been discovered by Dr. H. W. Taliaferro, formerly of the Johns Hopkins University and now of the University of Chicago.

When dangerous bacteria invade the human body, the automatic defensive mechanism of the body usually throws fighting units, called antibodies, into the front line trenches of the blood. These protective substances kill the harmful disease organisms.

The new substance found by Dr. Taliaferro is related to such usual antibodies. But instead of wiping out the invading army of germs, it prevents it from perpetuating itself.

Working on a harmless blood parasite of rats, similar to the organism causing tropical sleeping sickness, Dr. Taliaferro found that the parasite, after an initial period of active multiplication apparently lost the power to reproduce its kind. Furthermore, by certain experimental procedure, he found that this peculiar occurrence is due to some substance produced in the rat's blood, and that blood serum containing this substance could be used to stop reproduction of the parasites in new infections.

This seems to be an entirely new kind of "antibody" action. Generally, serums, anti-toxins and like substances act either by destroying the disease-p.oducing organisms or neutralizing their poisons. With this newly discovered substance, however, the case is different; it tolerates the existence of a few organisms, but literally forces race suicide on them by preventing them from multiplying. It remains now to discover whether in human sleeping sickness a similar action exists or can be induced. This problem Dr. Taliaferro is attacking.

African sleeping sickness is due to a microscopic animal known as a trypanosome and is closely related to the organism found in rats' blood. There are two varieties of tropical sleeping sickness in Africa, the Gambian and the Rhodesian; and one variety in the tropical parts of South America. The Gambian variety of Africa is the more serious one. All the tropical sleeping sicknesses are carried by insects, just as malaria and yellow fever are carried by mosquitoes.

Besides the tropical sleeping sickness, there is another entirely distinct disease in the temperate zone, called by the same name. This ailment, *Encephalitis lethargica*, which has been making some trouble in northern countries for some years, has never been traced to its cause, though it is probably due to an ultra-microscopic germ that can pass through the pores of a fine filter.

ITEMS

Science Service

SOAKING garden seeds to give them a running start also increases their speed through life, according to reports from the Plant Breeding Station at Proskau, Germany. Radish seed soaked for two or three hours in solution of magnesium chloride or magnesium sulphate give an increase in leaf and root development and a more than tripled yield in the most striking of the treated plants. Even soaking in pure water more than doubled the yield. Officials of the U. S. Department of Agriculture state that simply taking precautions to start with disease-free seed may lead to a false impression of stimulated growth. The department has been studying the effects of chemicals in destroying seed-borne parasites. Treated seeds may lead to normal healthy plants and such merely healthy plants may give the impression of leading a faster life when compared with sister plants from untreated seed. The Department of Agriculture is now launched on experiments which will determine whether there is a genuine speeding-up of the life of plants from the soaking of seed as the Proskau experiments suggest.

THE German Institute for Research in Human Food has reached the conclusion that beer does not amount to so much after all—that it is not nearly as effective a stimulant as tea. Results of a comparison of the two beverages were announced in Munich recently. A half liter of Munich beer containing about 15 grams of alcohol brought about an acceleration of mental action for about twenty minutes, followed by a period of noticeable depression lasting twice as long. A cup of tea, on the other hand, drove the mental capacity higher by about ten per cent. for three quarters of an hour, after which the subject of the experiment returned to normal without experiencing the ill effects that followed the alcoholic stimulant. The scientists warned, however, that the average amount of stimulating caffein in the ordinary cup of tea is about one tenth of the maximum medical dose so that there may be real danger if large amounts are imbibed at one time. A small amount of tea has relatively a greater effect than a larger amount.

EIGHT species of rare shore birds, *en route* from their summer homes in the far north to their winter feeding grounds in South America, made a stop of several days in Washington recently. It is many years since any of them has been seen in that vicinity, for they usually fly closer to the coastline, but a heavy storm is believed to have turned them from their course and led them to seek shelter there.

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SCIENCE NEWS

THE REPORTED TRANSMUTATION OF MERCURY

Science Service

THE transmutation of mercury into gold, which was recently reported to have been accomplished by Professor A. Miethe, of Berlin University, and generally questioned by other chemists, is now announced to have been confirmed by his collaborator, Dr. H. Stammreich. He claims to have repeated Meithe's experiment, using mercury, which careful analysis had shown to be "absolutely free from any trace of gold," but which at the end of the process was found to contain appreciable amounts of the precious metal.

Approximately one and one half kilograms of mercury were used in a mercury arc lamp. The lamp was operated for 197 hours with from 160 to 175 volts at 12.6 ampères. The gold produced is said to have amounted to eighty-two millionths of one gram, or a little less than three ten millionths of an ounce.

The conversion of mercury into gold is admitted by American and English scientists to be possible, but the sufficiency of the energy used and the reliability of the tests applied by the Germans for the detection of the gold have been questioned.

Dr. R. A. Millikan, winner of the Nobel prize for physics last year, in response to an inquiry by *Science Service*, declared that no experiments on the production of gold from mercury have been made or planned in the Norman Bridge Laboratory, Pasadena, California, of which he is director. He points out that "reliable results are very difficult to obtain because traces of gold are practically always found in mercury anyway."

Professor W. D. Harkins, of the University of Chicago, well known for his work on atomic structure, declares that in the mercury vapor lamp, with which Professor Miethe claims to have produced gold, the energy brought to bear upon the atoms of mercury is exceedingly small in comparison with the amounts of energy in all actual artificial disintegrations thus far accomplished.

"According to accepted theories it also seems probable," he says, "that such small amounts of energy would not be able to penetrate the outside of the atom to get at the nucleus at all. Professor Haber found gold in Miethe's mercury, and this is undoubtedly accurate, but Haber disclaims all knowledge of how the mercury got in. Experts in this field will not trust any reports of atomic disintegration by large or small currents, unless voltages of millions of volts have been used, until they are supported by experimental work carried out with the most extreme precautions in such a way as to give definite evidence that the results claimed have been obtained. It is possible that Miethe has such evidence. I have not repeated his experiments.

"Mercury would be converted into gold if a hydrogen nucleus were lost from or an electron added to mercury's nucleus. I have bombarded argon nuclei by helium nuclei with an energy corresponding to five million volts without their disintegration. The voltage used in a mercury vapor lamp is small."

The products of Professor Miethe's first experiment were analyzed in the laboratory of Dr. Fritz Haber, famous for his work on nitrogen fixation. Professor Haber, when in this country recently, informed a *Science Service* representative that silver as well as gold was found in the samples submitted. This is taken to indicate that both silver and gold were present as original impurities of the mercury, since they are usually associated together in mercury ore.

Dr. Frederick Soddy, the English chemist at Oxford, stated in a British scientific publication that even in advance of the German announcements, it appeared to him that not only was such a transmutation possible but that it was inevitable unless our present views of atomic structure are radically at fault. He believes that the chemical detection of the gold produced, not the transmutation, would probably be the more formidable experimental difficulty.

THE "ROTOR" SHIP

Science Service

A SEVENTY-YEAR-OLD scientific principle, easily understood by any one who knows about baseball, is the trick that underlies the new "rotor" ship invented by Anton Flettner, according to German engineers and scientists who have examined the sensation-causing craft. The smooth surfaces of the great cylindrical "rotors," spinning in the wind, increase pressure on one side and decrease it on the other, just as the surface of the rapidly rotating baseball piles up a difference of pressure on its two sides and causes it to drift into a curve.

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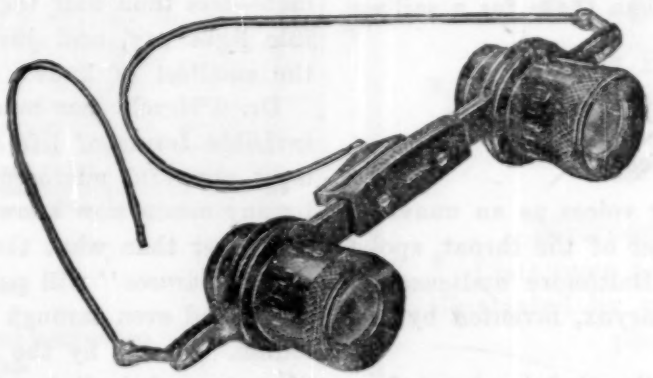

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This effect is known variously as the "Magnus" and the "Bernouli" principle, from the scientists who first made critical examinations of the phenomenon, in the middle of the nineteenth century. It has been noted in the drift down the wind of rapidly rotating rifle bullets and artillery projectiles, and all army range tables allow for it. But Herr Flettner is the first, so far as known, to attempt a commercial application.

One incidental advantage is claimed for the rotor ship that sets it ahead of either steam or sailing vessels. It can be turned on its own center by rotating the towers in opposite directions. It is claimed also that the ship can be stopped very quickly by reversing the direction of rotation of the towers. This is somewhat analogous to the stopping of a steamer by reversing the screw, and is a feature absent from sailing ships. There has been considerable question as to the stability of a rotor ship in a storm, but the inventor claims that the surface exposed to the tempest by the rotors is not so great as that exposed by the bare rigging of a close-reefed sailing ship.

Since rotor ships must have wind in order to move, they would be competitors only of sailing ships. Since the pressure difference must always be built up by a wind blowing across the ship in order to move it forward, the rotor ship is like the sailing vessel in that it can not sail directly into a head wind, but must tack across it. The sailing vessel has the advantage when the wind is directly astern, for then it can sail directly before it, whereas a stern wind is almost as useless to the rotor as is a head wind.

But Herr Flettner claims that this slight advantage is offset by the greater speed of his vessel, by its greater cheapness of construction, and above all by the very small crew required as compared with the men on a sailing ship. He states that operating costs for a rotor ship should be eighty per cent. lower than those for a sailing ship of the same tonnage.

A MECHANICAL LARYNX

Science Service

THREE mutes, deprived of their voices as an unavoidable result of operations for cancer of the throat, spoke distinctly and clearly before a Baltimore audience of medical men, using an artificial larynx, invented by Dr. John E. Mackenty.

Sufferers from cancer of the throat have heretofore been able to save their lives only at the expense of their voices, for the radical operation necessary in such cases necessitates the destruction of the vocal apparatus, and after recovery the patients must breathe through an opening in the neck. The new device is strapped over this opening, and receives air which it sets into vibrations similar to those caused by the natural vocal cords. This vibrating column of air is carried to the mouth by a small tube, and there modified into human speech by the lips and tongue. The result differs from ordinary speech mainly in that it is a monotone.

The new device, according to Dr. Mackenty, represents practically a philanthropic contribution to mankind. There are so few persons who require it, and the possible sales are so far between, that his efforts to interest manufacturers to develop the idea met with no response. Finally, executives of the laboratories maintained by the American Telephone and Telegraph Company and the Western Electric Company decided to undertake the work, even though no certain return of their expense was in sight. Using the knowledge of human speech acquired in their telephonic studies scientists of these laboratories have now produced a device which will enable many unfortunate people to talk again.

Not only will the artificial larynx add to its users happiness and earning power, but it will remove one barrier to the proper treatment of cancer of the throat. In the early stages of the disease, when a radical operation offers a practical certainty of cure, sufferers have often hesitated because they dreaded the loss of their voices. Delay, even while trying other treatments, has usually allowed the disease to progress to a point where cure is impossible. With the fear of future silence removed, Dr. Mackenty believes that sufferers no longer will risk their lives, but will have the cancerous tissues removed and do their talking with an artificial larynx.

INVISIBLE FORMS OF LIFE

Science Service

LIFE when it first appeared on this planet was in a form similar to the invisible "filterable viruses" now recognized as the causes of such diseases as hog cholera and leaf mosaic in plants, according to the claim of a Canadian scientist, F. d'Herelle, director of the laboratory of the International Sanitary Council at Alexandria, Egypt, and formerly at the Pasteur Institute, Paris.

These earliest beings had a diameter of twenty millimicrons, or approximately eighteen ten-millionths of an inch—less than half the shortest wave-length of any visible light ray, and just one tenth of the diameter of the smallest of known visible bacteria.

Dr. d'Herelle has made his life work the study of the invisible forms of life that lie beyond the reach of the most powerful microscope. Since they can not be seen by any means now known, he has had to study what they do rather than what they look like. He has found that these "viruses" will pass through the walls of the finest filter, and even through an apparently solid sheet of collodion. It was by the latter means that he learned the diameters of the living particles that compose the viruses, for the apparently solid collodion is known to have pores of almost infinite minuteness.

He contends that his tiny creatures, though invisible, are still alive; for they have the properties of all living beings. They feed, they reproduce, they adapt themselves to their environment, by suitable means they can be crippled or killed. They can be divided, according to the effects they produce, into definite species. One form causes a certain fatal disease in poultry and other birds, another causes temperate-zone sleeping sickness, and the several varieties of a third give rise to several varieties of diseases in man and other animals.

One, which is d'Herelle's special pet and private discovery, causes epidemics in the bacterial world, wiping

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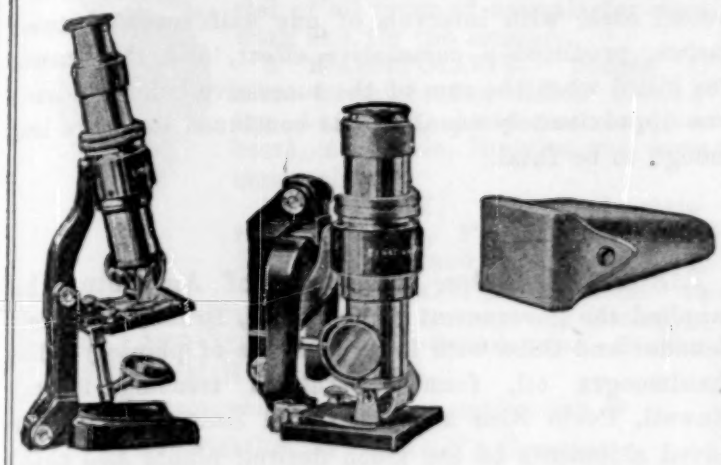

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out disease germs as disease germs wipe out people. This form, known as the bacteriophage, or "bacterium-devourer," caused a profound sensation when its discovery was announced, and is still the subject of much scientific controversy. Dr. d'Herelle claims, on the basis of this discovery, that health is really as contagious as disease, once the bacteriophage begins its crusade.

All this ultramicroscopic, ultrafiltrable world beyond the reach of sight Dr. d'Herelle has grouped together into a genus which he calls "protobios," or "primitive life," for he claims that nothing possessing life can be simpler than these creatures. He conceives a "protobe" to consist of a single "micella," or complex group of protein and other molecules.

A further interesting concept of Dr. d'Herelle's is that higher forms of life may be given rise to by the aggregation of micellae, and that at the borderline between protobes and ordinary microbes there are organisms that pass through both forms during their life cycle. He cites two instances to support his case. In one, the culture medium containing one of the lower bacteria was filtered to exclude all its cells. Yet the filtered liquid, with suitable food elements added, again gave rise to bacteria. In the second, the bacteria of a plant tumor disease were raised from bits of tumorous tissue in which no bacteria could be found by microscopic examination. It is as though a camel coming to the eye of a needle, could disintegrate into little bits and thus pass through; and the bits again reassemble into a camel on the other side.

Thus at least does Dr. d'Herelle argue. Micellae endowed with life are protobes; protobes may aggregate into microbes; microbes may differentiate and develop, becoming organized cellular structures like the simpler fungi and the protozoa; unicellular organisms may evolve into multicellular, "higher" plants and animals. The theory is too radical to have been fully accepted as yet; but it is certainly a bold picture and one to wonder over.

EFFECT OF ULTRA-VIOLET LIGHT ON LOWER ORGANISMS

Science Service

THE invisible ultra-violet light beyond the upper end of the spectrum, which has come into general use in hospitals for the treatment of a number of human ills, kills many of the lower forms of life like a stroke of lightning, according to the results of researches just made public by Drs. C. E. Barr and W. T. Bovie, of Harvard University.

The efficacy of ultra-violet light has long been known to depend on its destructive effect on protoplasm, which is the living substance that forms the basis of all animals and plants, but the present experiments have shown for the first time with what rapidity this destruction takes place.

Drs. Barr and Bovie used living protoplasm in its simplest available form; the animals used in their experiments were amoeba, which are naked and unprotected bits of protoplasm of microscopic size that crawl about in stagnant water. Exposed to ultra-violet light for one fourth of a second, an amoeba apparently suffered paralysis. It stopped moving and seemed dead, but after a time recovered. But if the exposure lasted three seconds the animal was killed and its substance broken down at once. One second of exposure killed the animal, but the disintegration of its body was sometimes delayed for a short time. Successive exposures of a fraction of a second each, with intervals of one half second between flashes, produced a cumulative effect, and the amoeba was killed when the sum of the successive brief exposures was approximately equal to one continued exposure long enough to be fatal.

ITEMS

THE United States Department of Agriculture has supplied the government of Colombia, Brazil, Venezuela, Ecuador and Cuba with large numbers of plants yielding chaulmoogra oil, found useful in treating leprosy. Hawaii, Porto Rico and the Canal Zone have also received shipments of the much desired plants and chaulmoogra trees will soon be fruiting widely in tropical America. Seeds for these plants were obtained in the wilds of Siam and Burma during a series of explorations begun in 1920 by the department's plant hunter, J. F. Rock. Chaulmoogra oil is now obtained from India where it is pressed cold and imported at great expense, but experts hope that within ten years tropical America will be supplying its own oil for the cure of leprosy. During the period of fourteen months ended March 15, 1924, 50 per cent. of the leprosy patients at the Kalihi Leprosy Hospital in Hawaii have recovered and been paroled as a result of chaulmoogra oil treatment, and during the past five years 260 patients have been discharged as cured.

STATISTICAL observations on birds over the north Atlantic ocean indicate that their number increases steadily toward the north, reaching a maximum in the seas between Norway and Iceland. The minimum is found in mid-ocean at about the latitude of North Carolina and the Straits of Gibralter. The data for this census of sea birds was obtained by Danish scientists during the past four years, with one earlier set of observations some ten years ago. In making their counts they dealt only with birds that spend most of their time at sea, like terns and albatrosses, and excluded shore birds and land birds in passage. One very prominent factor in determining the distribution of bird life seems to be the Gulf Stream. Where this current crosses the Atlantic, between Newfoundland and Britain, there is a considerable abundance of birds. Southward the number falls off abruptly. Between 30 and 40 degrees north latitude less than a tenth as many birds were observed as between 40 and 50 degrees. The number of oceanic birds increased near the land, on both sides of the Atlantic.

WHAT is described as the most important visitor from the skies ever to fall to earth has been discovered in the North African desert. It is an enormous mass of meteoric stone, with a volume in the neighborhood of 160,000 cubic meters. M. LaCroix, French geologist who studied the meteorite, says it contains some rare metals.

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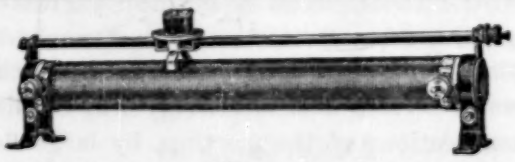

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SCIENCE NEWS

NAVY DIRIGIBLES AND THE ECLIPSE

Science Service

WHEN the moon eclipses the sun and throws a great shadow upon part of northeastern United States next January 24, the Navy's dirigible, the *Los Angeles*, will be used to secure scientific data, according to plans now being considered by the Navy Department at Washington.

Carrying a staff of astronomers and their scientific instruments high above any clouds that may be in the sky and far out to sea so as to lengthen the time of totality, the two helium-filled craft are expected to serve science effectively in recording this important event.

The Bureau of Naval Aeronautics, of which Admiral W. A. Moffett is chief, and the U. S. Naval Observatory, of which Captain Edwin T. Pollock is superintendent, are now making tentative plans for the use of the airship at the time of the eclipse. In a communication addressed to prominent astronomers throughout the country who are planning to observe the coming eclipse from the ground, Captain Pollock has asked their advice on the kind of observations that can best be made from the air.

Observations from the air have the advantages over those from the ground of less interference from clouds, and of avoidance of the strong absorption of the lower strata of the air. The latter advantage would be particularly favorable at an eclipse like the one of 1925 when the sun will be at a very low altitude. By going out over the ocean, the additional advantages of longer duration and of greater altitude of the sun could be secured. An airship offers several advantages over an airplane, as for example, a larger and steadier platform for instruments, and accommodation for professional astronomers.

Although observations requiring precise adjustment of instruments and long photograph exposures will not be possible from the airships, the program already planned includes determination of exact times of contact of moon and sun, photographs by a half dozen cameras, motion pictures of corona and disappearing and reappearing crescent, observations of the shadow bands, determination of the color and visibility of the corona, color effects and changes in the atmosphere, visibility of the stars and searches for comets and planets. The airship will be kept in touch with ground observers by radio and U. S. Naval Observatory time signals will be received in the same way.

Professor S. A. Mitchell, of the University of Virginia, and chairman of the eclipse committee of the American Astronomical Society and observer at five previous eclipses, has approved of the plan of using the dirigibles as observatories. Professor Ernest W. Brown, of Yale University, authority on the moon which will cause the eclipse, points out that aerial photographs of the edge of the shadow cast by the moon will help materially in determining whether the moon arrives at the times predicted by the astronomers.

The possibility of eclipse observations from the air was pointed out before the California eclipse of last year by Colonel John Millis, U. S. A., retired, and airplanes of the Navy and the Army were in the air during that event. Clouds and the speedy movement of the airplanes prevented results of scientific value being secured then but use of lighter-than-air craft is expected to bring better results.

A small party of astronomers from the Naval Observatory will form the nucleus of the scientific party. The fact that this event will occur in the morning at about 9 o'clock and the desirability of reaching as high an altitude as possible has resulted in a decision to reduce the crew of the airship to a minimum and limit the number of astronomers to be carried aloft.

Captain Edwin T. Pollock, superintendent of the U. S. Naval Observatory, has explained that the buoyancy of the dirigible will be decreased by the low temperature of early morning and the lack of sunshine. The great cigar-shaped ship will steal out of its giant hangar at Lakehurst before daylight on the morning of the eclipse in order that it may climb high above any clouds that might obscure the eclipse and station itself some distance out to sea where the time of total eclipse is longer. It it probable that only six or seven scientific observers, under Captain Pollock's direction, will be accommodated.

By going out to sea where the period of totality of the eclipse will be longer and by rising high above any obscuring clouds or fog, the *Los Angeles* is expected to be the means of obtaining pictures of the solar corona which has never before been satisfactorily photographed in all respects in this stage of its development. Colored motion pictures of the highly colored streamers shooting out from the sun during totality will be attempted for the first time in history. It is hoped that these observations will be of value to the study of sunspots and the resulting magnetic disturbances on the earth which affect telegraph and cable communication and probably have some effect on radio communication. Daily observation of the sun and its spots are a part of the regular program of the Naval Observatory.

THE PAN-AMERICAN SCIENTIFIC CONGRESS

Science Service

THE third Pan-American Scientific Congress will meet at Lima, Peru, from December 20 to January 6, according to plans made public by the Pan-American Union. All phases of science and technology will be discussed in the various sections of the meeting, by large delegations from the Latin-American countries and the United States. The nine sections include: History and anthropology; physical and mathematical science; mining, metallurgy, geology and applied chemistry; engineering; medicine; biology, agriculture and zootechnics; private, public and international law; economics and sociology; education.

There will be ten official delegates from the United States, together with approximately twenty-five unofficial delegates. The official group includes: Dr. L. S. Rowe, president of the American Academy of Political and

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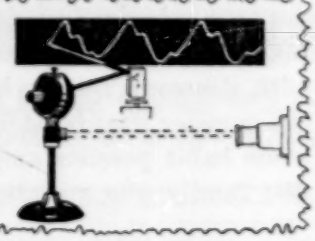

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The Pan-American Scientific Congress is an outgrowth of the Latin-American Scientific Congresses, which met in Buenos Aires in 1898, in Montevideo in 1901 and in Rio de Janeiro in 1905. The United States was invited to participate in the fourth meeting, which thus became the first Pan-American gathering. This meeting was held at Santiago, Chile, in 1908–09. The second Pan-American meeting was held at Washington in 1915–16, and was participated in by delegates from all the American republics. Over a thousand attended from the United States.

ARTIFICIAL EARTHQUAKES FOR FINDING OIL

Science Service

ARTIFICIAL earthquakes, produced by detonating large charges of explosives, are the latest aids invoked by the oil geologist in his search for petroleum-bearing rock formations. Dr. L. Mintrop, a German seismologist, is the originator of the method.

Oil pools are usually found in or under the dome or ridge of an "anticline," or inverted V-shaped fold of deeply-buried rock. It is important therefore to know the direction and degree of slope of the layers in a rock formation where oil is to be sought.

Dr. Mintrop's method depends on the fact that earth tremors, upon striking a massive layer of rock, are reflected in much the same fashion as waves in a pool striking the shore, or like sound waves striking a cliff and producing an echo. A heavy charge of explosive is fired, and the resulting ground waves are recorded by portable seismographs set up at suitable distances. The characteristics of these reflected waves, particularly the amount of extra time they have required to reach the instrument as compared with the waves which have traveled direct without reflection, furnish data for calculating the inclination of the rock strata. The process is repeated several times, until enough information is gathered to tell whether or not the folds in the rocks underground are favorable for the location of oil.

This method of locating rock strata, and calculating the amount and direction of their slope, it is pointed out, is especially advantageous in level regions where there is a thick blanket of surface soil, and where there are no mountains or rock ledges to give the geologist a hint of the kind and arrangement of the subterranean rock structures.

STONES COLLECTED BY EXTINCT BIRDS

Science Service

LITTLE heaps of semi-precious stones, scattered over the plains and hills of New Zealand, mark the last resting-places of the moas, gigantic ostrich-like birds only recently extinct. The moa, which was the largest bird that ever existed, carried pebbles in its gizzard, just as ordinary chickens do, to grind up its food. Since it lived largely on tough twigs of bushes, it needed especially hard stones. Where it lay down to die at last, the pebbles endured after even its bones had disappeared. Hence the little heaps of rounded chalcedony, quartz, chert, jasper and quartzite, ranging in size from 2½ inches in length and 2 ounces in weight downward.

Professor W. T. Lee, of the U. S. Geological Survey, who calls attention to this phenomenon, comments on the good judgment of these extinct birds in choosing jewel stones for use in their lapidary mills. "By judicious selection of material, these first families among diamond cutters handed down lasting memorials to admiring posterity," is the way he puts it. Professor Lee also calls attention to the similarity in habit between these ancient birds and the still more ancient dinosaurs, who also swallowed hard semi-precious stones to grind their food. Collections of such stones have been found associated with dinosaur fossils, in approximately the spots where the monster lizards' stomachs found repose. The gizzard-stone habit persists among modern reptiles in the crocodile family who are also rock-eaters.

THE SEX RATIO

Science Service

WHY are there more boy babies than girl babies? Dr. F. A. E. Crew, director of the animal breeding research department of Edinburgh University, has been striving to find an answer to this question.

He has studied thousands of birth records, human and animal. He finds that the relative number of males and females among the new-born young are influenced by the time of year that the mating takes place, the size of previous family and the interval that has elapsed since the last birth.

In all the higher animals, man included, the number of males and females born runs nearly, but not quite, equal. There is always a slight preponderance in favor of one sex or the other, which varies from species to species. Thus in the human race, the ratio of boys to girls is between 103 and 107 to 100. Among horses, female colts are more numerous than males, the male-female ratio being 98 to 100; and the same ratio prevails among sheep. Happily for those who are in the egg business, pullets are more numerous than cockerels at hatching, with a ratio of 95 male chicks to 100 female chicks. But with pigeons the numerical supremacy of the males is restored with a ratio of 115 to 100.

The sex-ratio varies with the seasons of the year. A study of the birth records in greyhound kennels shows that December breedings produced 88 male puppies to 100 females, while the ratio of male to female for Sep-

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tember breedings was 122 to 100. Similar records show that the offspring of warm-weather matings among horses were in almost the same proportions as those of cold-weather matings, but that other farm animals showed a wider range. Among cattle the warm-weather ratio was 114 to 100, as compared with 103 to 100 when the mating took place in the fall and winter. Sheep showed a ratio of 102 to 100 for the warm months as compared with 94 to 100 for the cold, and pigs showed ratios of 115 to 100 and 109 to 100, respectively, for summer and winter matings.

CHRISTMAS GREENS

Science Service

HOLLY, winterberry, mountain laurel, ground pine and a number of other plants used in Christmas wreaths and garlands are being used so fast that unless the present generation becomes more moderate in its demands there will be none left for the Christmasses of the next, is the gist of a warning issued recently by P. L. Ricker, of the Wild Flower Preservation Society.

"Of all woody plants in the East, holly and its close relative winterberry are in the greatest danger of extermination," says Mr. Ricker. "Around large towns where they were formerly common one has to go farther away each year to find them, and most of the holly that reaches the market has been stolen. The problem is so serious that immediate steps for its cultivation are urged."

Another seriously threatened plant, Mr. Ricker states, is the ground pine, which forms the basis of most Christmas garlands. Unlike the holly, this plant can not be successfully cultivated, and the only thing that will save it from eventual complete destruction is greater moderation in its use. The society strongly advocates the substitution of artificial garlands to as great an extent as possible, and the use of cultivated and potted plants, like dwarf orange, poinsettia and Jerusalem cherry, to replace branches cut from the woods.

PLANTS AND SOLAR ENERGY

Science Service

ENERGY from the sun pours on every acre of ground to the equivalent of 1,476 tons of coal during an average 90-day growing season. Of this wealth of power a crop of wheat yielding 50 bushels to the acre, a very high figure, puts into the bin an energy equivalent of less than two thirds of a ton of coal. These striking figures are given by Dr. H. A. Spoehr, plant physiologist of the Carnegie Institution Coastal Laboratory at Carmel, California, writing in the forthcoming annual report of the Smithsonian Institution.

But inefficient as plants are, Dr. Spoehr points out, they have been the only means of major importance we have had for capturing solar energy and making it available for man's use. The coal and oil deposits, representing sun power captured during long periods and stored ages ago, are being used thousands of times faster than they were originally made, and we shall soon find ourselves up against the proposition of getting our energy supply from day to day as we need it.

Plants, in Dr. Spoehr's opinion, do not hold much promise of effective usefulness when that time comes. They can not work fast enough, and besides, plant production must be increasingly used to supply food and little can be spared for fuel. Man must use his ingenuity to duplicate and improve upon the process that plants have used for ages, and devise means for the direct capture of the great quantities of sunlight energy that daily waste themselves around us. Little progress has been made so far, but Dr. Spoehr is confident that when the problem is attacked in earnest by scientists it will eventually be solved.

ITEMS

Science Service

SILK purses were made out of sows' ears several years ago by a chemist. Now comes a botanist, Dr. F. W. T. Huenger, of Amsterdam, who has made an equally impossible-sounding discovery. He has found pearls in coconuts. The gems are round, perfect in form, milk-white, but lack the iridescent sheen of the oyster pearl. They are very rare and difficult to secure, for the natives of the tropical islands prize them highly as talismans and are reluctant to part with them. They are formed by a process similar to that which produces shell-fish pearls. Certain coconuts are "blind," that is, they do not have the three "eyes" at the end, to one of which the embryo of the seed is normally attached. Caged inside the nut and unable to develop normally, the embryo becomes impregnated and covered with lime salts from the milk of the coconut.

To cheat death at grade crossings in the state of Washington, railway rolling stock should be painted a bright color and compelled to stop to let automobile traffic clear the way, according to proposed state highway traffic law for enactment by the coming legislature. "There are hundreds of automobiles to every train that goes over a grade crossing," states the first draft of the measure, "the machines may stop—wise drivers always do—but the trains do not. Accidents also occur because the railway coaches being painted green, the same color as the scenery, are hard to see during the daytime and impossible at night or in a fog. Change this to yellow or white, make the trains stop, and grade crossing fatalities and mishaps will be cut a hundredfold."

DISSECTION so fine, and done with such fine tools, as to be possible upon single cells as small as three thousandths of an inch in diameter, is being practiced by Dr. Henry J. Fry, of New York University. His instruments are fine glass needles of his own manufacture, drawn out to a point almost invisibly slender, and his operating stage is the field of a microscope. Heretofore work of this kind has been done only with special machines. Dr. Fry does not claim that his method will do away with these microdissection machines, but states that for many kinds of scientific work the operations can be carried on with much greater freedom and rapidity, yet without sacrificing necessary accuracy.

Psychology without the 'ism

The Field of PSYCHOLOGY—1924

By MADISON BENTLEY, Ph.D.,
Professor of Psychology and
Director of the Psychological Laboratories
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The Field of Psychology is designed to orient the trained individual outside the subject as well as to inform the student of psychology. To the man of science, venturing outside of his own *Fach*, a new "ism" offered in a foreign discipline may, for the want of guidance, appear as plausible and as generally representative as a seasoned body of facts and principles. The credulity frequently displayed by physicists and biologists in alleged instances of "telepathy," "clairvoyance" and "mediumship" illustrates the difficulty of sound and authentic judgment in matters beyond one's specific training.

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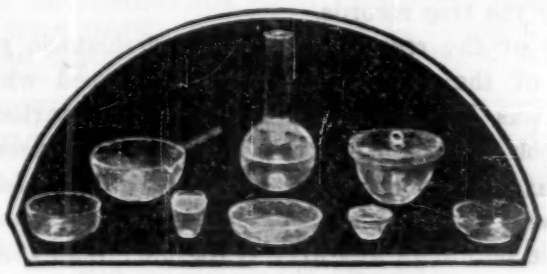

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SCIENCE NEWS

TREE RINGS AND WEATHER CYCLES

Science Service

TREES as prehistoric almanacs, giving weather reports for ages when there was no other weather bureau to record them, are described by Professor A. E. Douglass, of the University of Arizona, in the annual report of the Smithsonian Institution.

Professor Douglass's studies are based on minute examination of annual rings of trees. Beginning with the common knowledge that these rings are formed at the rate of one a year, the light, porous section growing in the spring when there is plenty of water and the denser part when the summer drought comes, he went on to study the effect of years of drought as compared with years of plenty, of accidents to the roots, of fires and of attacks of disease. Every event in the life of a tree left its record in the rings.

After learning the correlation between known historical conditions and comparatively recent tree rings, Professor Douglass began to carry his researches back into earlier centuries, using trees of the age-old forests of the Southwest as his "time-sticks." Weather records of the time of the discovery of America, of the Crusades, of the Norman invasion of England, and of even more remote periods, can be read on many stumps in California.

One of the interesting pieces of information shared by the trees is a confirmation of the theory of an eleven-year sunspot cycle held by astronomers and weather students. Every eleven years there is a band of relatively narrow rings, indicating a time of heat and drought, with wider rings that tell of easier times in between. Secondary sunspot cycles of longer duration are also suggested by the tree records.

In one of the recently discovered prehistoric pueblos a study of the construction timbers showed what the weather was like when the building was started, how long it took to erect it and how the work progressed more rapidly at some times than at others. By "matching rings" with beams in another pueblo, it was found that one of the buildings was fifty years older than the other.

Many similar possibilities have been opened up by the development of the method. Perhaps one of the most fascinating is the idea of studying the weather conditions of long past geological ages by the study of rings in fossil trees, hundreds of thousands or even millions of years old.

ORION IN THE EVENING SKY

(Isabel M. Lewis, Science Service)

ORION, the Warrior, the most popular and widely known constellation in the heavens, visible from all corners of the world because of its position on the celestial equator, has returned once more to the evening sky and may be seen towering majestically above the eastern horizon by nine o'clock in the evening.

The quaint star maps of the ancient astronomers pictured Orion with uplifted club in his right hand, its tip close to the horns of Taurus, the Bull, which he faces, and with a lion's skin thrown over his uplifted left arm. Four brilliant stars outline the hero's huge form. Two—ruddy Betelgeuse in the right shoulder, and blue-white Rigel diagonally opposite in the left foot—are of the first magnitude. The remaining two—Bellatrix in the left shoulder, and Saiph in the right knee—are of the second magnitude. The left foot of Orion rests upon Lepus, the Hare, the small constellation directly below Orion, and his head is marked by a group of three faint stars. At his heels follow the two dogs, Canis Major, which contains Sirius, the brightest star in the heavens, and Canis Minor, farther north, with its first magnitude star Procyon. Depended from the Belt of Orion, which is marked by three stars of the second magnitude in a straight line slanting toward the southeast, is the famous Sword of Orion, containing a line of faint stars, the central one rather fuzzy in appearance. Viewed through the telescope this fuzzy, starlike object is transformed into what is generally considered to be the most magnificent object in the heavens, the Great Orion Nebula, a glowing mass of luminous gases of enormous size and extent which includes in its ramifications the entire constellation.

The Orion Nebula is most brilliant in the neighborhood of the multiple star Theta, which is embedded in its heart. This star and its surrounding nebulosity is the fuzzy stellar object that is visible to the naked eye. Small telescopes break this star up into a system of four stars, but more powerful telescopes show that it is really a sextuple star, that is, six gigantic suns forming one enormous system.

According to the latest investigations the luminous gaseous nebulae, of which the Great Orion Nebula is the most illustrious example, owe their luminosity either to the reflected light of stars associated with them or to electrical excitation produced in some way by these stars or to both causes. It is probable, then, that the multiple star Theta in the heart of the Great Orion Nebula is largely responsible for the brilliancy of its surrounding nebulosity.

The most reliable estimates place the typical Orion stars, such as the brilliant Rigel, the three stars in the Belt of Orion and the stars in the Sword of Orion, at a distance of approximately six hundred and fifty light years from the earth, or nearly four thousand trillion miles. All these Orion-type stars are intensely hot with temperatures of ten or twelve thousand degrees Centigrade or over and with the element helium conspicuously present in their spectra.

The red variable star Betelgeuse, which has been in the past few years one of the most talked of stars in the heavens because of its huge size, is not a member of the Orion group of stars. Its distance from the earth is less than two hundred light years or about one third that of the true Orion stars. It is merely seen projected against the background formed by the more distant stars in a convenient position to complete the outlines of this celestial figure which man has fashioned out of the stars and which will some day lose its distinctive form as surely, if not as fleetingly, as the forms we picture in summer clouds.

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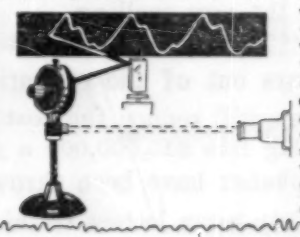

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THE NEW RUSSIAN ALPHABET

Science Service

SPELLING reform, for which President Roosevelt, Andrew Carnegie, and many prominent American scholars struggled vainly a dozen years ago, has been accomplished for the Russian language by the Soviet administration.

The reforms in the Russian alphabet, as announced by the Russian Ministry of Education, by shortening the written language by one twelfth and making its spelling twice as logical, are declared by Dr. John P. Harrington, ethnologist of the Smithsonian Institution, to be of material advantage in the study of this difficult Slavic language.

Dr. Harrington also pointed out that it is fortunate for Russia that this reform has been declared at just this time. "Spelling reform failed in America largely because practically all Americans could read and write already, and were reluctant to change what they had learned, but in Russia it is different. Illiteracy is still common in Russia, and the great mass of the people have nothing to unlearn. When education becomes universal among them, as it is finally bound to, it will be based on the new spelling.

"The changes should effect a saving of about four years out of the education of every Russian child and they will reduce the cost of printing in Russia by something like $15,000,000 a year. Five of the letters of the alphabet have been thrown out bodily, reducing it from thirty-seven letters to thirty-two.

"The spelling of Russian has remained unaltered since it was standardized by Peter the Great and the grammarian Lomonosov, in the eighteenth century. No change was allowed, though in many ways the orthography was most whimsical.

"For instance, the Russians were using two kinds of 'e'. One word might require the variety of 'e' known as 'ye', and another would call for the 'e' known as 'yat'. There were also two kinds of 'i', one written like our own 'i' and the other like our 'u'. The 'dotted' kind was written before a vowel, and the 'double' before a consonant. No word was allowed to terminate in an unpalatalized consonant, a 'hard sign', as useless as the mute 'shewa' of Hebrew, having to be written at the end. All this nonsense has been eliminated, and Russian is now the most scientifically spelled language of Europe.

"The question was raised in the Ministry of Education of introducing the Roman alphabet, which is the one we use in writing English, instead of the modified Greek character in which Russian has always been written. Psychologists claim that the Roman small letters, with their projections above and below the line, present a contour more readily grasped by the eye than the solid blocks of Russian lower case characters, which are practically all the same height and correspond to our small capitals. Thus 'malchik', which is the Russian word for 'boy,' in Russian type is a rectangle, while 'boy' in Roman type has projecting signals. But the advocates of retaining and 'scientificizing' the Russian alphabet prevailed."

Russian is now written without the dotting of an "i" or the crossing of a "t", which cause the lifting of the hand from the paper in writing English.

Dr. Harrington also told of the history of the Russian alphabet. "In the ninth century two alphabets were introduced among the Slavs in the vicinity of Salonika," he stated. "They have since become known as the Glagolitic and the Cyrillic alphabets. They were founded on the cursive Greek alphabet of the time; but much as the Slavs may wish to deny it, two of the letters "sha" and "shcha" were supplied by the Jews. They are merely the three-pronged "shihn" of the Aramaic alphabet.

"The Glagolitic form is now used only in Croatia and Dalmatia, while the Cyrillic is employed by all Russians, Servians and Bulgarians. It is the form in which the earliest Russian New Testament translation was written in 1057 A. D., and to which the Russian Ministry of Education has now given the benefits of scientific improvement."

THE MEXICAN BEAN BEETLE

Science Service

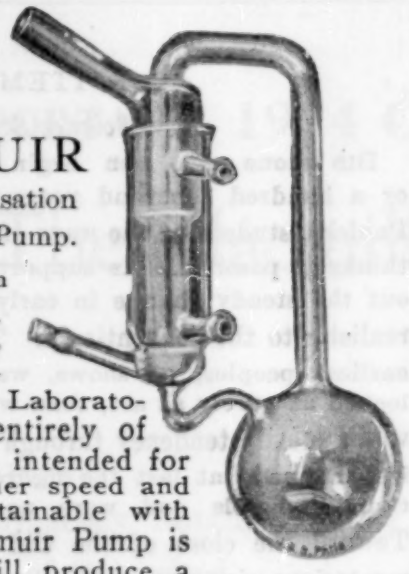
A DESTRUCTIVE invasion of the farm lands of the eastern United States by hordes from Mexico, which started in central Alabama in 1920, has now reached the shores of Lake Erie. The defense, entrusted to the Department of Agriculture, has resisted with all the means at its disposal, but has been unable to prevent a great extension of the enemy's front with each year's campaign.

The invader is the Mexican bean beetle. Long known in the Southwest as a moderately destructive, but not alarming pest of truck and farm crops, it was never reported from the East until 1920, when it became troublesome in a half-dozen counties in central Alabama. By the following summer the invaded area had been increased sixfold, making extensions into Tennessee and Georgia. In 1922, further extensions carried the war into central Kentucky and the western parts of the Carolinas. In 1923 the first raid outside of Dixie occurred, and the beetle reached central Ohio, and this year its range covers virtually the entire state.

It is extending eastward much more rapidly than it is moving toward the west, probably because its migration is controlled by the wind, which is prevailingly from the west. Its stronghold is the Allegheny highlands, for it likes to over-winter in dry, upland woods and can not thrive on well-cultivated lands or in marshes and swamps. For the latter reason, probably, it has not gained much ground to the south.

The beetle itself is a large member of the same family as the familiar little "lady-bird" beetles. It is about one fourth of an inch long, and has eight black spots on each of its copper-colored wing-covers. Both the beetle and the larva are very destructive feeders, stripping the soft green parts out of the leaves and leaving them as mere skeletons on the plant.

The bean beetle now makes a third unwelcome immigrant that has reached this country from Mexico. The other two are the potato beetle and the boll weevil.



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RACES OF LICE

Science Service

LICE have scientific value as well as intensely practical interest. Therefore, Dr. H. E. Ewing, specialist in such creeping things for the U. S. Bureau of Entomology, has made a study of them.

He has found that as races mingle the vermin that plague them mingle also, and hybridize. Any ex-soldier can tell of the too great intimacy of the front-line trenches and how the Russian body-louse reached the American dough-boy *via* the German and French armies.

But Dr. Ewing is more interested in the fundamental race problems presented by the head-plaguing vermin, or "graybacks." He finds that in America the head lice of Caucasian, Indian and Negro are all merged in a conglomerate hybrid breed; there seems to be no color line in this unsavory universe of the unwashed.

To find records of graybacks in the pride of their ancient racial purity he has had to turn to the past. The heads of mummies supplied him with material. A few Egyption lice were turned up; but the best crops were yielded by mummies from ancient Peru and from the old Indian dwellings of our own Southwest. And the inhabitants of the hair of these oldest inhabitants, before the present palmy days of racial melting-pots, were quite distinct. There was a Peruvian type of head louse, a Southwest Indian head louse, a head louse peculiar to the white men of Egypt. And the ancient American vermin are quite distinct from modern Asiatic types captured from the Chinese and Japanese.

Another interesting result of Dr. Ewing's studies seems to indicate that the long-tailed monkeys of the American tropics owe us humans a grudge, for the vermin that afflicts them apparently were passed on to them by man. We may boast—or try to conceal—a simian ancestry, but it seems that the things the simian scratches for traveled the other way.

EFFECTS OF CLOSE INBREEDING

Science Service

THE largest-scale inbreeding experiment ever conducted has failed to show any disadvantage in the mating of close relatices, provided the stock is good to start with, according to results just announced at the Wistar Institute of Anatomy and Biology of the researches of Dr. Helen Dean King.

Dr. King's investigation dealt with the data for twenty-five successive generations of albino rats, comprising over 25,000 individuals, that were obtained by the closest form of inbreeding possible in mammals—the mating of brother and sister from the same litter.

Comparisons made between inbred and stock animals, reared under similar conditions of environment and of nutrition, show unmistakably that inbred rats are larger, more fertile, and that they attain sexual maturity earlier and possess greater vigor of constitution than do stock animals.

The conclusion is drawn that inbreeding, *per se*, is not injurious, provided that the animals inbred are of sound stock and that there is a careful selection of the individuals that are used for breeding.

ITEMS

Science Service

DID stone age men begin to learn to write fifty or a hundred thousand years ago? Professor William Paulcke, student of the ways of the ancient cave dwellers, thinks it possible. As support for his theory he points out the steady change in early stone age art, from the realistic to the conventional. The cave paintings of the earliest peoples, he shows, were much better pictures, looked at purely as art, than were the later ones. There was a steady tendency through the early ages to formalize art, until at last the figures became simply conventional symbols and were no longer pictures at all. Toward the close of the Old Stone Age they painted mysterious signs on pebbles, which have been found in the upper strata. They may have been merely playthings; but Professor Paulcke points out that the present-day Australian aborigines have similar painted stones and sticks. The figures on these ancient pebbles are strikingly like the picture-writings of the Chinese, Babylonians, Egyptians and Mayans.

ELECTRIC locomotives of a new type, that carry their own transformer stations and "step down" a high-voltage alternating current to a low-voltage direct current, are being installed on the New York, New Haven and Hartford Railroad, and, according to statements of William S. Murray, engineer in charge of electrification, promise to open a new era in motive power for railroads. One of the main obstacles in the way of complete electrifications of railroads has been the wide differences in the requirements for transmission of electric current and for its best use. Electricity is most economically transmitted as alternating current of high voltage. It can be most efficiently and economically used as direct current at low voltage. Until the present time, electromotive engineering has had to be content with compromises. Less economical types of motors have had to be used, and railroads have had to maintain costly "step-down" transformer stations along the right of way. The new locomotives carry their own transformers with them, and change 11,000 volt alternating current which they take directly from the trolley wire to lower voltage direct current which is fed to their motors.

CEDAR oil can now be produced in paying quantities from shavings and waste wood in cigar box factories, by a process worked out in the laboratories of the Bureau of Plant Industry, U. S. Department of Agriculture. The oil can be used with cheaper, odorless woods, to make the aromatic boxes insisted on by cigar manufacturers. This discovery is expected to be of importance to the cigar industry, for the small West Indian cedar from which cigar boxes are made is becoming increasingly scarce. The cost of obtaining the oil is relatively small, and after its extraction the waste can still be used, as at present, for fuel.

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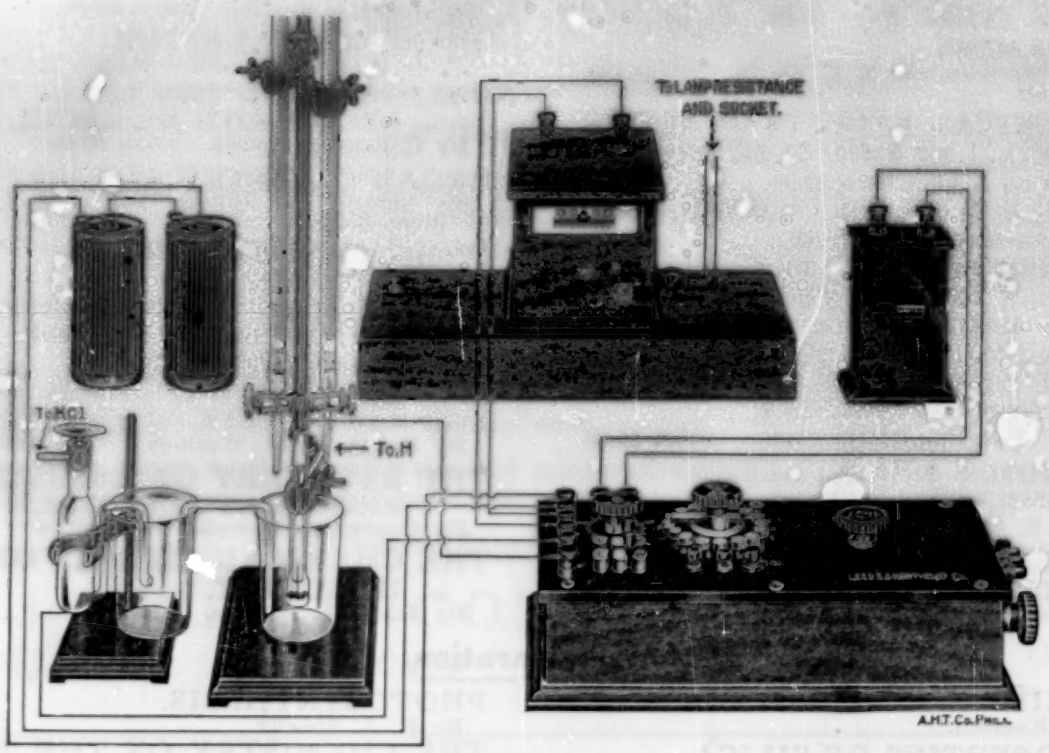

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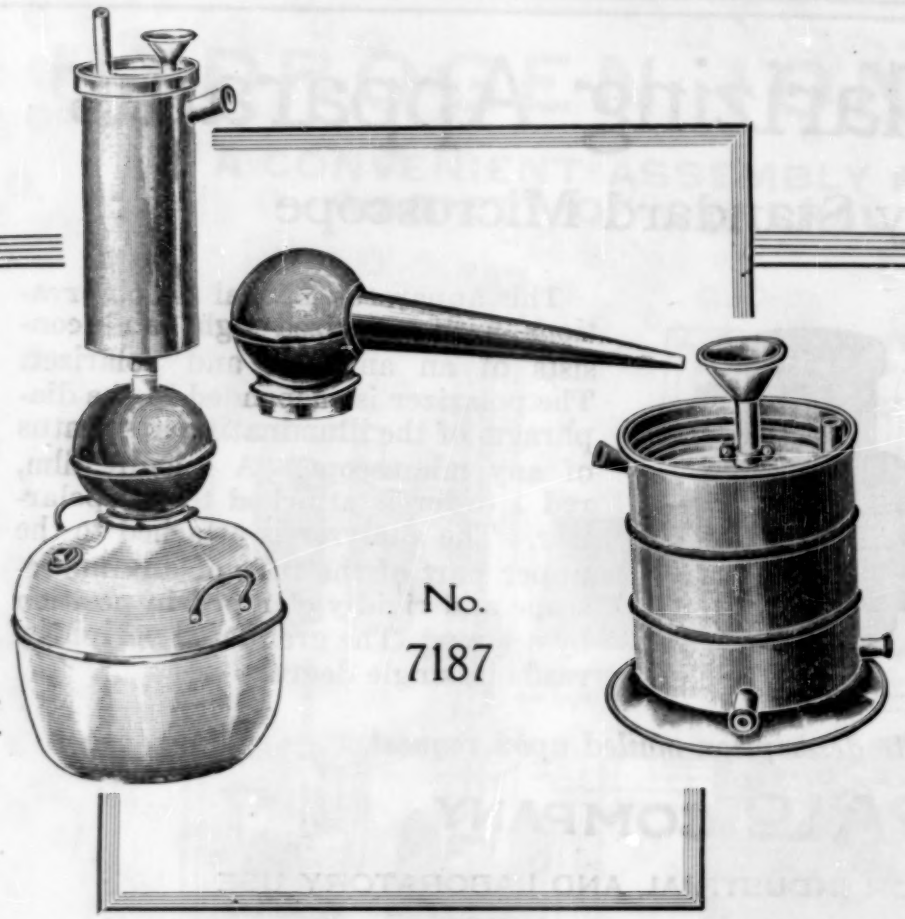

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The Cambridge Measuring Microscope

This is an instrument for the accurate measurement of lengths up to 40 millimeters. It gives readings directly to .01 millimeter or by estimation to .001 millimeter.

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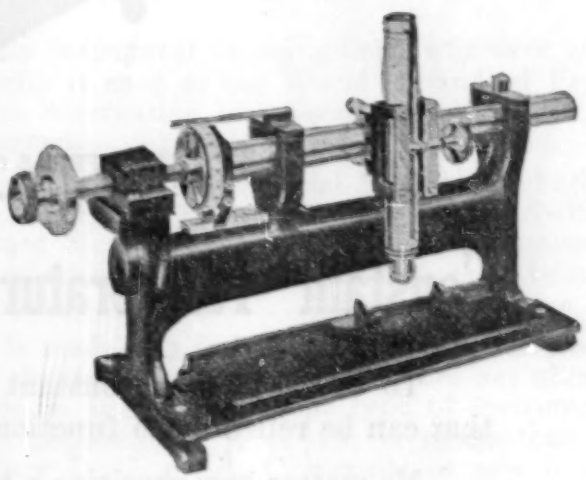

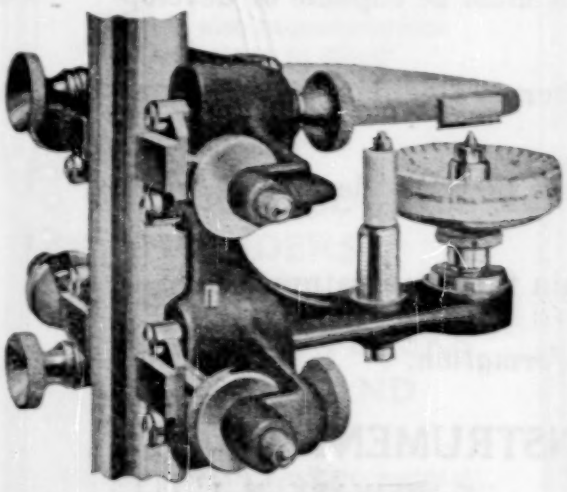

The Cambridge Extensometer

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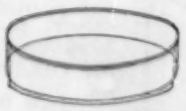

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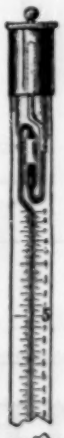

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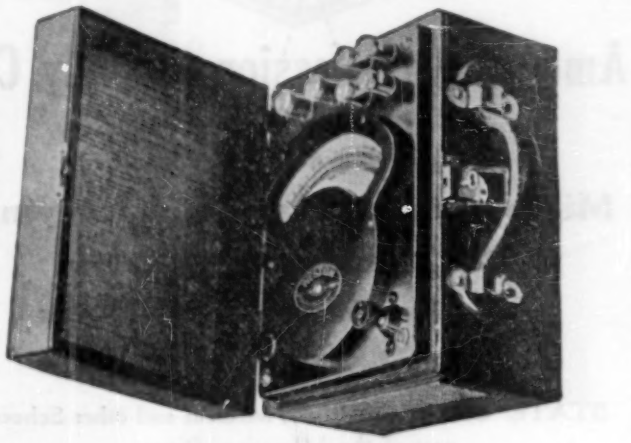

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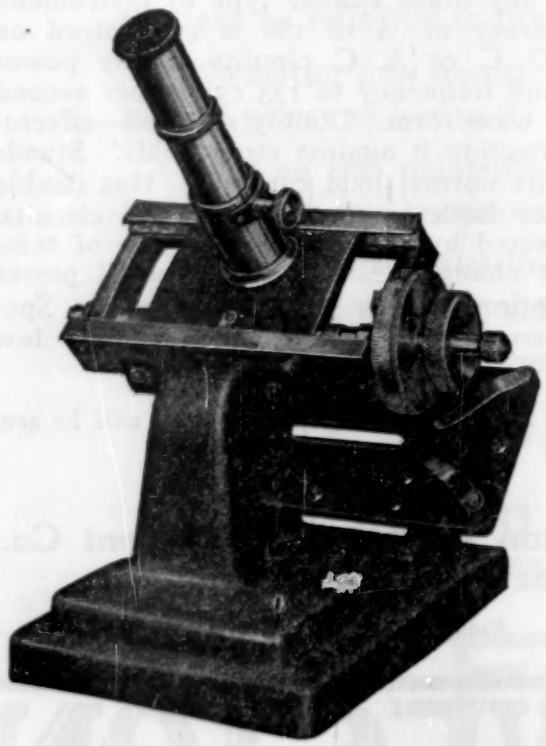

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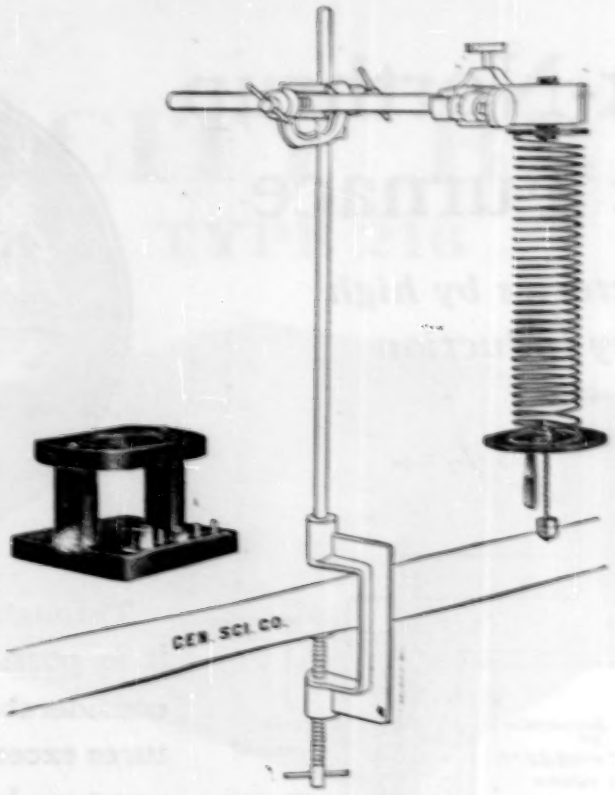

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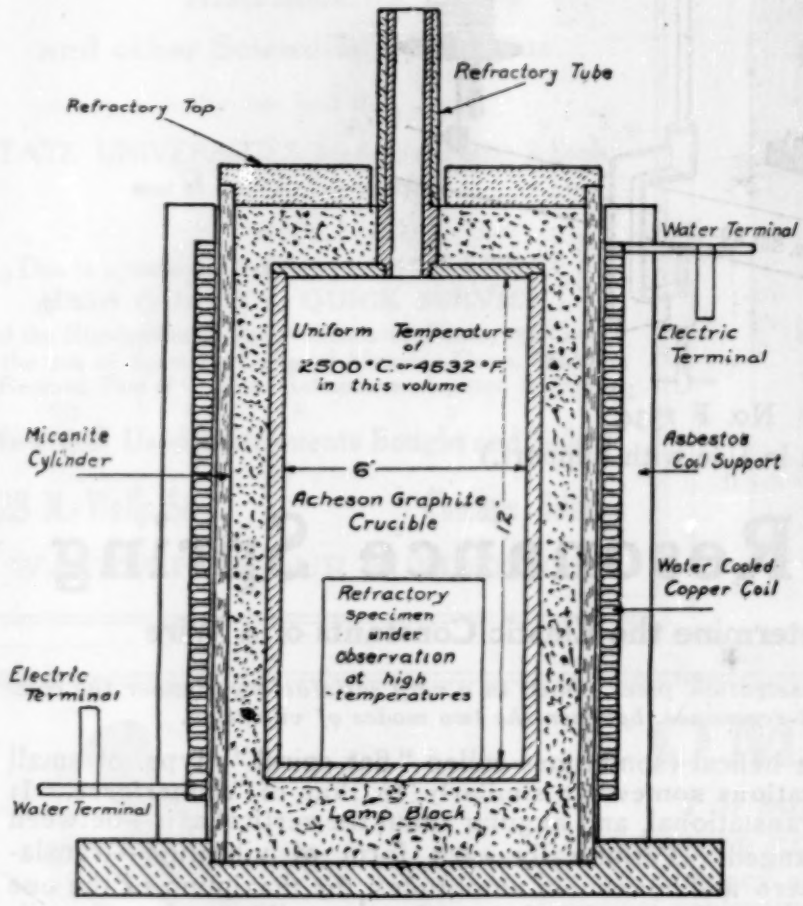

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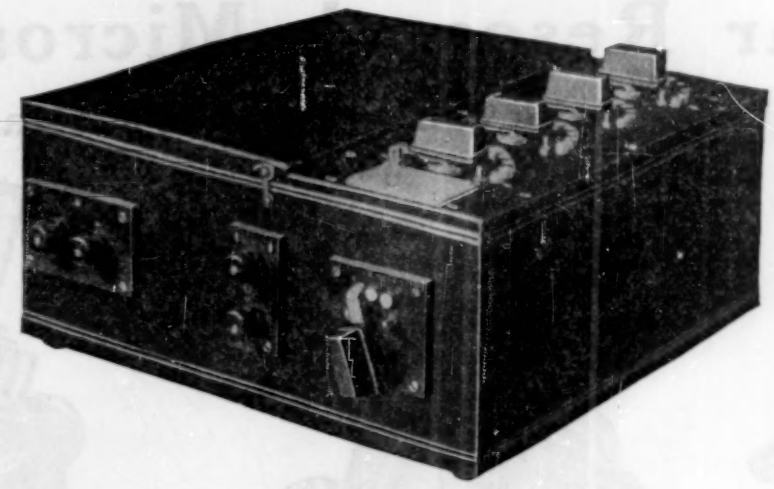

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